Volume 24, Number 24 December 31, 1970

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 50388, 50396, and 50439.

50321 GAS CHROMATOGRAPHY IN THE RESEARCH AND DEVELOPMENT PROGRAMS OF THE JUNTA DE ENERGIA NUCLEAR. Gasco, L.; Barrera, R.; de la Cruz, F.; Martin-Mira, J.; Perez-Garcia, M. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 13: 233-46(May-Jun 1969). (In Spanish).

Important studies made by the Junta de Energia Nuclear on gas chromatography in the areas of organic coolants for nuclear reactors, food preservation by irradiation, production of labeled molecules and isotopes, and radiation chemistry are summarized. The gas chromatographic analysis results on mixtures of biphenyl and biphenyl oxide, biphenyl and terphenyl isomers, and hydrogenated terphenyls are reported. The pyrolytic and radiolytic products of these mixtures were determined. In the study of food preservation, gas chromatography was used to determine volatile compounds of fruit aromas. Gas chromatography is used routinely to control the purity of labeled molecules and isotopes. The radiation chemistry studies centered on the behavior of methyl sulfoxide exposed to γ radiation. (J.S.R.)

Chemical and Spectral Procedures

Refer also to abstracts 50524, 50645, 50650, and 50651.

50322 (AAEC/TM-552) PROCEEDINGS OF A SYMPOSIUM ON THE ANALYTICAL CHEMISTRY OF URANIUM AND THORIUM HELD AT LUCAS HEIGHTS, SYDNEY, N.S.W., MAY 7-8, 1970. Florence, T. M. (ed.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug 1970. 132p. (CONF-700538).

Twenty papers are included; a separate abstract was prepared for each. (J.G.B.)

For abstracts of individual papers see: 50323-50336, 50348-50352, and 50354.

50323 (AAEC/TM-552, pp 3.1-4) DETERMINATION OF URANIUM IN ORES BY X-RAY FLUORESCENCE. Champion, K. P.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

X-ray and chemical results for uranium determination in ores are compared. The x-ray fluorescence method is discussed generally. (Australia)

50324 (AAEC/TM-552, pp 3.5-7) ANALYTICAL PROCEDURE FOR THE X-RAY FLUORESCENCE DETERMINATION OF URANIUM IN ORES. Champion, K. P.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

Apparatus and detailed procedure are given for the x-ray determinations of uranium in ores. The incoherently scattered Mo line from an Mo target x-ray tube was used as an internal standard. Results were within ±5% of the amount present. Precision was determined largely by counting statistics. (Australia)

50325 (AAEC/TM-552, pp 4.1-4) POLAROGRAPHIC DETERMINATION OF URANIUM IN ORES. Batley, G. E.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

The polarographic behavior of uranium is discussed in relation to its application to analytical procedure. Analytical methods are outlined. (Australia)

50326 (AAEC/TM-552, pp 4.5-7) ANALYTICAL PROCEDURE FOR THE POLAROGRAPHIC DETERMINATION OF URANIUM IN ORES. Batley, G. E.; Florence, T. M.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

A detailed polarographic method of determination is given. With a uranium concentration of 2×10^{-4}M, the precision was ±1 to 2%. With the use of a 1-g sample, the limit of detection was 100 ppM of U. (Australia)

50327 (AAEC/TM-552, pp 5.1-6) SPECTROPHOTOMETRIC DETERMINATION OF URANIUM. Florence, T. M.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

Improved chromogenic reagents used in the spectrophotometric determination of uranium(VI) are discussed in detail. (Australia)

50328 (AAEC/TM-552, pp 5.7-12) ANALYTICAL PROCEDURE FOR THE SPECTROPHOTOMETRIC DETERMINATION OF URANIUM IN ORES AND WATERS. Florence, T. M.; Johnson, D. A.; Farrar, Yvonne J.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

Recommended procedures are outlined for the determination of uranium in waters using 0.05% 2-(5-bromo-2-pyridylazo)-5-diethylaminophenol (bromo-PADAP) and in ores by initial extraction with trioctylphosphine oxide (TOPO), followed by complexing with bromo-PADAP. The direct method gave a precision of ±0.5% at the 50-μg U level. The use of TOPO with ores gave ±1.6% precision and limit of detection 15 ppM U_3O_8 using a 0.1-g sample and 4-cm path length. (Australia)

50329 (AAEC/TM-552, pp 6.1-4) FLUORIMETRIC DETERMINATION OF URANIUM. Pakalns, P.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

Recent improvements in the techniques used to determine uranium fluorimetrically are described, and a comparison between previous and present methods is presented from the points of view of fluxes, flux melting, fluorimeters, standardization, extraction from salting solutions, precision, quenching interference, and dissolution of ores. (Australia)

50330 (AAEC/TM-552, pp 6.5-8) ANALYTICAL PROCEDURE FOR THE FLUORIMETRIC DETERMINATION OF URANIUM IN ORES AND WATERS. Pakalns, P.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

A detailed method of fluorimetric determination is described. A precision of ±5% was obtained at all uranium concentrations. (Australia)

50331 (AAEC/TM-552, pp 7.1-6) TITRIMETRIC DETERMINATION OF URANIUM. Florence, T. M.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

The reductimetric titrations of U(VI) to U(IV) and the oxidimetric titration of U(III) or (IV) to U(VI), with various standard reagents, are discussed. (Australia)

50332 (AAEC/TM-552, pp 7.7-10) ANALYTICAL PROCEDURE FOR THE TITRIMETRIC DETERMINATION OF URANIUM IN CONCENTRATES. Florence, T. M.; Pakalns, P.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

A high-precision redox method of determining uranium in concentrates, based on that of Davies and Gray, is described. Uranium(VI) is reduced to uranium(IV) by ferrous sulfate in concentrated phosphoric acid medium. Excess iron(II) is then selectively oxidized by nitric acid using a molybdenum catalyst. After addition of sulfuric acid and dilution with water, the uranium(IV) is titrated with standard potassium dichromate, using barium diphenylamine sulfonate indicator. (Australia)

50333 (AAEC/TM-552, pp 8.1-4) SPECTROGRAPHIC DETERMINATION OF URANIUM. Dale, L. S.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

Methods of spectrographic determination are reviewed. Results are given of determinations on various samples. Particular attention is given to reducing matrix effects. (Australia)

50334 (AAEC/TM-552, pp 8.5-8) ANALYTICAL PROCEDURE FOR THE SPECTROGRAPHIC DETERMINATION OF URANIUM IN ORES. Dale, L. S.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

A description is given of a spectrographic determination of uranium in low-grade ores. A lead chloride–graphite buffer is used to reduce matrix effects with Ti as an internal standard. Precision obtained using various techniques ranged from ±0.1 to ±0.3%. (Australia)

50335 (AAEC/TM-552, pp 11.1-3) SPECTROPHOTOMETRIC DETERMINATION OF THORIUM. Florence, T. M.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

Reagents used in the spectrophotometric determination of thorium are compared. Interfering elements and ions for each are listed. (Australia)

50336 (AAEC/TM-552, pp 11.4-8) ANALYTICAL PROCEDURE FOR THE SPECTROPHOTOMETRIC DETERMINATION OF THORIUM IN ORES AND WATERS. Pakalns, P.; Florence, T. M.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

Thorium was determined in ores by a method that involved preliminary extraction of U, Zr, and other heavy metals using Alamine-336 followed by use of the chromagenic reagent Arsenazo III. Direct analysis in water had a precision of ±0.5% at the 50-μg Th level. The limit of detection in ores was 5 ppM Th for a 0.5-g sample. (Australia)

50337 (CONF-690916-(Vol.2), pp 244-51) ANALYSIS OF PLUTONIUM. PART I. CHEMICAL METHODS. Chitnis, R. T.; Laxminarayanan, T. S.; Naik, B. P.; (and others) (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

Potentiometric, volumetric, and coulometric methods for the estimation of plutonium were studied and standardized. Using these methods, the plutonium content of PuO_2 samples was determined and a precision of better than 0.2% was attained. The values from the three different methods agreed within 0.5%. (auth)

50338 (CONF-690916-(Vol.2), pp 290-7) SPECTROGRAPHIC DETERMINATION OF SOME LANTHANIDES AND ACTINIDES IN URANIUM AND PLUTONIUM. Joshi, B. D.; Patel, B. M. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

An emission spectrographic method for the estimation of some rare earths and Am in uranium and plutonium has been developed. An anion exchange separation procedure has been used for the separation of rare earths. The estimation ranges in ppM on the basis of 100 mg sample are: Ce 12.5 to 50, Sm 5 to 50, Gd, Er, Eu 0.5 to 5.0, Dy 1.25 to 12.5, Ho, Eu 2.5 to 25 and Yb 0.5 to 2.5. The standard deviation ranges from 8 to 14%. The effects of common impurities have also been studied. (auth)

50339 (CONF-690916-(Vol.2), pp 298-302) SPECTROGRAPHIC METHOD FOR THE DETERMINATION OF RARE EARTHS IN PLUTONIUM: USE OF TRILAURYL AMINE. Dhumwad, R. K.; Joshi, M. V.; Patawardhan, A. B. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

Methods for the isolation of rare earths, such as Gd, Sm, Dy, Er, and Ce, in 100-mg plutonium samples and their estimation by spectrography are described. The estimation ranges in ppM are Gd 10 to 100, Sm 50 to 300, Dy 5 to 100, Er 5 to 200 and Ce 100 to 600, the over-all standard deviation being 14%. The effects of impurities like Ca and Fe are also described. (auth)

50340 RAPID SEPARATION AND DETERMINATION OF URANIUM(VI) BY USE OF DEAE ANION-EXCHANGE PAPER AND THE RING-OVEN TECHNIQUE. Abe, S.; Weisz, H. (Univ., Freiburg i. B.). Mikrochim. Acta; No. 3, 550-2(1970).

A rapid method for the separation and determination of uranium(VI) in the presence of Cu and Fe is described. The separation of uranium (0.09 to 0.35 mg/ml) from various other metals is carried out on DEAE anion-exchange paper with an n-butanol–acetic acid–water system (1:1:1, vol/vol), and the determination completed by the ring oven method. (auth)

50341 PROGRESS IN THE ANALYTICAL CHEMISTRY OF NEPTUNIUM (A REVIEW). Mikhailov, V. A.; Novikov, Yu. P. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 25: 1792-1810(Sep 1970). (In Russian).

Data on the analytical chemistry of the first transuranium element, neptunium, have been systematized. The peculiarities of its analytical determination are conditioned by the fact that it is formed in irradiated uranium and is present in solutions in ultrasmall concentrations. Various methods for neptunium separation (precipitation, coprecipitation, electroprecipitation, chromatography, sublimation, extraction) and for its determination (radiochemical, spectrophotometric, titrimetric, electrochemical) are examined. (134 references.) (auth)

50342 DETERMINATION OF CERTAIN LANTHANIDES AS IMPURITIES IN SCANDIUM OXIDE BY A LUMINESCENCE METHOD. Poluektov, N. S.; Gava, S. A. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 25: 1735-9 (Sep 1970). (In Russian).

A method was developed for determining microimpurities of Nd, Sm, Eu, Dy, Er, Tm, and Yb in scandium oxide preparations. The method is based on measuring the luminescence intensity of the rare earth ions in the scandium vanadate crystal phosphor. The sensitivity of the method is $n \times 10^{-4}$ to $n \times 10^{-6}$%. (auth)

50343 DETERMINATION OF NEODYMIUM AS MICROIMPURITY IN EUROPIUM OXIDE BY THE LUMINESCENCE SPECTRA OF CRYSTAL PHOSPHORS. Anikina, L. I.; Karyakin, A. V.; Le Viet Binh (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 25: 1731-4(Sep 1970). (In Russian).

A luminescent method for determining neodymium in europium oxide with the use of crystal phosphors based on $YVO_4 + EuVO_4$ (2:1) was developed. The sensitivity of the method is 2×10^{-4}%. The reproducibility of the determinations is 20%. (auth)

50344 USE OF THE RATE OF NUCLEAR MAGNETIC RELAXATION IN INORGANIC ANALYSIS (A REVIEW). Popel, A. A. (Kazan State Univ.). Zh. Anal. Chem.; 25: 1781-91(Sep 1970). (In Russian).

A review of the method is given and its possibilities are described using various titers of selective organic reagents for the determination of diamagnetic ions (In^{3+}, Ga^{3+}, and Th^{4+}). (R.V.J.)

50345 COLORIMETRIC DETERMINATION OF MOLYBDENUM IN SOILS, SEDIMENTS, AND ROCKS BY ZINC DITHIOL. Stanton, R. E. (Sheen Labs., Queen's Park, Australia). Australas. Inst. Mining Met. Proc.; No. 235, 101-2(Sep 1970).

Samples weighing 0.2 g were digested with 2 cc of 72% $HClO_4$ for 2 hr at 180°C and then diluted with 10 cc H_2O. After settling, an aliquot of clear solution was reduced with ascorbic–citric acid, and zinc dithiol solution was added to form a colored Mo

complex which was extracted with petroleum spirit for comparison with standards. Concentrations to 2 ppM may be analyzed at rates to 150 determinations per day. (auth) (Australia)

50346 EQUILIBRATION OF ORTHO- AND PARA-HYDROGEN ON ALUMINA AT 77°K AND ITS INFLUENCE ON THE DETERMINATION OF SMALL AMOUNTS OF EXCESS PARA H_2, D_2, AND HD IN THE PRESENCE OF LARGE AMOUNTS OF NORMAL H_2. Quickert, K. A.; Le Roy, D. J. (Univ. of Toronto). Can. J. Chem.; 48: 2532-7(15 Aug 1970).

When alumina is activated sufficiently to separate excess para H_2, D_2, and HD in a gas-solid chromatographic column at 77°K using normal H_2 as the carrier gas, appreciable ortho-para equilibration takes place on the alumina. A kinetic study of the equilibration process was made, as the result of which procedures were established which made it possible to determine small concentrations of excess para H_2 in the presence of normal H_2. If D_2 and/or HD are also present in the sample, the observed peak area for excess para H_2 is subject to correction terms which are directly proportional to the concentrations of D_2 and/or HD. (auth) (Canada)

Isotopic Procedures

50347 (NYO-844-81) NUCLEAR CHEMISTRY AND GEOCHEMISTRY RESEARCH, CARNEGIE-MELLON UNIVERSITY. Progress Report, 1969-1970. Kohman, Truman P. (Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Chemistry). 30 Jun 1970. Contract AT(30-1)-844. 111p. Dep. CFSTI.

Developments are reported for studies on: $^{146}Sm-^{142}Nd$ and $^{147}Sm-^{143}Nd$ systems as dating methods; U-Th-Pb decay-growth functions; long-lived transuranium α emitters and another anomalous α emitters in natural materials; Moessbauer spectroscopy of coal-related minerals; isotopic composition of lead and thallium in natural materials; chronology of galactic heavy-element nucleosynthesis; natural radioactivity of ^{48}Ca; general scheme of chemical analysis of lunar and meteoritic samples; mass spectrometry; chemical procedures for purification of U and the α spectroscopy of U; α-isotope-dilution analysis of U and Th; least-squares analysis of experimental α spectra; and design and construction of a position-sensitive proportional counter. (P.C.H.)

Radiometric Procedures

Refer also to abstracts 50446 and 50566.

50348 (AAEC/TM-552, pp 2.1-12) DETERMINATION OF URANIUM IN ORES BY RADIOMETRIC ASSAY. Porritt, R. E. J.; Bone, S. J.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

The beta-gamma and gamma spectrometric methods of determining uranium are discussed and compared. Both methods are suitable for routine analyses. Results are also compared with those obtained by use of chemical or x-ray fluorescence methods. A bibliography is included. (Australia)

50349 (AAEC/TM-552, pp 2.13-16) ANALYTICAL PROCEDURE FOR THE RADIOMETRIC DETERMINATION OF URANIUM IN ORES. Bone, S. J.; Porritt, R. E. J.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

Details of apparatus and procedure for determining uranium in ores by the beta-gamma and gamma spectrometric methods are given. The precision of the beta-gamma method is ±25%, and that of the gamma spectrometric method is better than ±10%. With the use of 100-g samples, the limits of detection were 20 ppM and 5 ppM respectively. (Australia)

50350 (AAEC/TM-552, pp 9.1-15) RADIOISOTOPE INSTRUMENTS FOR ANALYSIS OF URANIUM SOLUTIONS. Alfredson, P. G.; May, J. R.; Ridley, J. L.; Ryan, R. K.; Yates, P. B.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

The design and construction of instruments used at the AAEC's Lucas Heights Research Establishment for gamma-absorptiometry and for x-ray fluorescence analysis are described. Their usefulness for on-line applications and rapid batch analysis of uranium solutions in the range 0.01 to 400 g u/l is indicated. (Australia)

50351 (AAEC/TM-552, pp 10.1-5) DETERMINATION OF THORIUM IN ROCKS AND ORES BY RADIOMETRIC ASSAY. Porritt, R. E. J.; Bone, S. J.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

The ^{232}Th decay chain is considered and attention is drawn to the ^{208}Tl peak in the gamma ray spectrum for analytical purposes. (Australia)

50352 (AAEC/TM-552, pp 10.6-7) ANALYTICAL PROCEDURE FOR THE DETERMINATION OF THORIUM IN ROCKS AND ORES BY γ-SPECTROMETRY. Porritt, R. E. J.; Bone, S. J.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N. S. W., May 7-8, 1970.

Details are given for the analysis for thorium by γ spectrometry. A precision of ±5% was obtained provided $>10^5$ counts above background for sample and standard were accumulated. (Australia)

50353 (CONF-690916-(Vol.2), pp 252-6) ANALYSIS OF PLUTONIUM BY CHEMICAL AND RADIOMETRIC METHODS. PART II. DETERMINATION OF SPECIFIC ACTIVITY AND ISOTOPIC COMPOSITION OF PLUTONIUM. Srinivasan, N.; Ramaniah, M. V.; Jain, H. C. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

The specific activity of plutonium samples was determined using a gas-flow proportional counter and liquid scintillation counter. The isotopic composition of plutonium in the above samples has been determined using α spectrometry with a solid state detector. (auth)

Activation Procedures

Refer also to abstract 50660.

50354 (AAEC/TM-552, pp 2.17-19) ANALYSIS FOR URANIUM BY THE NEUTRON-ACTIVATION DELAYED-NEUTRON METHOD. Bone, S. J.

From Proceedings of a symposium on the analytical chemistry of uranium and thorium held at Lucas Heights, Sydney, N.S.W., May 7-8, 1970.

The principle and limitations of the neutron-activation, delayed-neutron method of assaying for uranium in rocks and minerals are briefly described. (Australia)

50355 (CONF-690916-(Vol.2), pp 85-9) DETERMINATION OF NITROGEN IN IRON METEORITES. Goel, P. S. (Indian Inst. of Tech., Kanpur).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

Various methods, such as activation analysis, fusion method, and Kjeldahl method were used for the determination of nitrogen in iron meteorites. The results showed that the nitrogen present in iron meteorites is in the form of more than one compound. The fusion method decomposes the compounds completely and gives total nitrogen. The same is true for activation analysis. The most striking result was the finding of large variations in nitrogen contents in samples of the same meteorite taken from nearby regions. Data are tabulated. (P.C.H.)

50356 (GA-9822) APPLICATIONS OF NEUTRON ACTIVATION ANALYSIS IN SCIENTIFIC CRIME INVESTIGATION. Annual Report, June 1, 1968-May 31, 1969. Guinn, V. P.; Hackleman, R. P.; Lukens, H. R.; Schlesinger, H. L. (Gulf General Atomic, Inc., San Diego, Calif.). 21 Jan 1970. Contract AT(04-3)-167. 94p. Dep. CFSTI.

Forensic activation analysis research conducted during the period, June 1, 1968 through May 31, 1969, is described. During this period, a large number of test firings of revolvers and automatic pistols were performed, followed by hand sampling with paraffin and neutron activation analysis (NAA) of the paraffin handlifts for barium and antimony. Occupational "handblank" samples were obtained by the same procedure from persons of a number of additional occupations and similarly analyzed for barium and antimony. A bivariate normal statistical treatment method was developed for the interpretation of the accumulated gunshot-residue and handblank data. As applied to the data obtained thus far, it is a promising method. An analogous multivariate normal statistical treatment method was investigated for treatment of the more than two variables observed in NAA data on paint, paper, and bullet lead. (auth)

50357 (ORO-2670-40) RADIOCHEMISTRY AS APPLIED TO GEOCHEMICAL PROBLEMS: NEUTRON ACTIVATION ANALYSIS. Progress Report, August 1, 1969-July 31, 1970. Ehmann, William D. (Kentucky Univ., Lexington. Dept. of Chemistry). 1 Oct 1970. Contract AT(40-1)-2670. 27p. Dep. CFSTI.

Research on nondestructive techniques in activation analysis and gamma-gamma coincidence spectrometry applied to activation analysis is reviewed. Thermal neutron activation and γ-spectrometry utilizing high resolution Ge(Li) detectors were used to determine the abundance of Na, Fe, Th, Cr, La, Hf, Cs, Sc, Co, Eu, Si, Au, and Hg in australites from documented sites. The analysis of representative tektites from the major occurrences indicated that Australasian tektites are all very similar in chemical composition. Neutron activation analysis was used to determine gold in a group of igneous rocks occurring in an igneous-sedimentary belt of southeastern Manitoba. Bismuth was determined in 15 chondrites and 6 U. S. Geological Survey standard rocks, by α-counting of the ^{218}Po daughter activity. (J.G.B.)

50358 NEUTRON ACTIVATION ANALYSIS OF TOTAL-BODY PHOSPHORUS IN MICE. Williams, James L.; Cargol, Lawrence H.; Pailthorp, Keith G.; Nelp, Wil B. (Univ. of Washington, Seattle. Battelle Northwest Labs., Richland, Wash.). Contract AT(45-1)-2046. J. Nucl. Med.; 11: 576-9(Oct 1970).

A simple procedure for uniform irradiation of mice with 14-MeV neutrons is described. A nondestructive technique for measuring total-body phosphorus has been developed that is precise and accurate. The results show good agreement with those obtained by chemical analysis. (auth)

50359 ACTIVATION ANALYSIS OF ^{60}Co ENCAPSULATED IN STAINLESS STEEL NEEDLES. Hallaba, E.; Azzam, R.; Al-Assaly, F. (Atomic Energy Establishment, Cario). Microchim. Acta; No. 3, 536-43(1970).

Cobalt-60 clinical sources have wide applications in cancer treatment. Nondestructive activation analysis has been employed to assess the radiometric purity of cobalt needles encapsulated in stainless steel sheet after pile irradiation. The main radioimpurities detected in these needles are ^{54}Mn, ^{59}Fe, and ^{51}Cr. Although the activity of the impurities represented 21% of the total activity within 15 days after irradiation, the purity of needles improves rapidly to about 99% after 7 months. Moreover, increasing the amount of irradiated cobalt would result in high-specific-activity needles with the same radiometric purity within a reduced cooling period. (auth)

50360 ACTIVATION ANALYSIS WITH CHARGED PARTICLES AND GAMMA PHOTONS. Isotop. Radiat. Technol.; 8: 118-21 (Fall 1970).

Analytical applications of charged-particle or γ-photon activation for the determination of light elements, such as B, C, N, O, and F, in high-purity materials, such as Si, Ge, Fe, Ni, and Nb, are discussed. Data on nuclear reactions used and lowest concentrations determinable with the activation method, as found at Saclay, are tabulated. (P.C.H.)

50361 NEUTRON METHOD FOR THE DETERMINATION OF INDIUM AND CADMIUM CONCENTRATIONS IN A FLOWING SOLUTION. Kartashev, E. R.; Shtan, A. S. Tr. Vses. Nauch.-Issled. Inst. Radiats. Tekh.; No. 3, 200-6(1969). (In Russian).

Automatic equipment was developed for the simultaneous continuous determination of In (2 to 30 mg/l) and Cd (5 to 20 mg/l) in flowing discharge solutions from the hydrometallurgical process for In and Cd extraction. Cd was determined by the neutron absorption method using thermal neutrons. In was determined by the neutron activation method, by recording the induced γ activity or by measuring the β activity of the short-life ^{116}In. Pu-Be, supplying ~5×10^6 neutrons/sec, was used as the neutron source. In the determination of In it is necessary to correct for changes in Cd concentration. The error in determining Cd is ±5%. (Metals Abstr.)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 50396, 50410, 50434, 50439, 51212, 51213, 51407, 51806, and 51839.

50362 (CONF-690916-(Vol.1)) PROCEEDINGS OF THE CHEMISTRY SYMPOSIUM, CHANDIGARH, SEPTEMBER 23-26, 1969. VOLUME I. INVITED TALKS AND INVITED PAPERS. (Department of Atomic Energy, [Bombay] (India). Chemistry and Metallurgy Committee). 1969. 239p.

Thirty papers are included; separate abstracts were prepared for eight. The remaining 22 papers contain information on: application of high resolution NMR in inorganic chemistry; nonaqueous solvents; ESR spectroscopy and coordination chemistry; application of Moessbauer spectrometry to coordination compounds; ir spectroscopy of high-temperature molecules; magnetically ordered solids; ligand exchange studies using ESR; nature of Fe(III) in HCl-organic solvent media; Ti(IV) complexes with sulfur-containing ligands; peroxo complexes of Zr; SnI_4-dioxane systems; molybdenum carbonyl complexes; distorted octahedral complex of Co(III); preparation and structure of Co(II) and Ni(II) complexes; I-substituted tetrazoline-5-thiones as complexing agents; chemistry of noble gases compounds; preparation of high specific activity tritium-labeled amino acids; homogeneous exchange of bromine between zinc bromide and acetyl bromide; luminescence behavior of europium chelates; coordination chemistry of rare earths; thermogravimetric analysis of formates of rare earths and Y; and rare earth and yttrium tartrates. (P.C.H.)

For abstracts of individual papers see: 50363, 50364, 50397, 50398, 51409, 51815, 52551, and 52552.

50363 (CONF-690916-(Vol.1), pp 92-7) WATER AND POLYWATER. Rao, C. N. R. (Indian Inst. of Tech., Kanpur).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. I.

Spectroscopic and theoretical studies on the structure of liquid and solid H_2O and D_2O and polywater are discussed. Observations on polywater have been interpreted in terms of strong symmetric O-H... O bonds (akin to HF_2^-). In polywater, oxygen sp^2 orbitals seem to be involved in hydrogen bonding rather than the sp^3 orbitals. M. O. calculations seem to establish the presence of symmetric short hydrogen bonds in polywater. (P.C.H.)

50364 (CONF-690916-(Vol.1), pp 224-32) INTERACTION OF THORIUM(IV) AND URANIUM(VI) WITH ADENINE. Khan, M. M. Taqui; Krishnamoorthy, C. R.; Reddy, P. Rabindra (Indian Inst. of Tech., Madras).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. I.

Studies were made on the preparation and stability of adenine complexes with Th(IV) and U(VI). Titration curves of the complexes in 1:1 and 2:1 ratios of ligand to metal ion could not be completed because of the separation of a solid phase before the inflection point. The precipitation may be due to the fact that purine forms very insoluble compounds with metal ions. The stabilities of the complexes, however, were calculated in a region of the titration curve well ahead of the precipitation point. It was found that the Th(IV) complexes have higher stability than U(VI) as expected from higher charge on Th(IV) as compared to U(VI). (P.C.H.)

50365 (CONF-690916-(Vol.2), pp 259-60) THERMODYNAMICS AND KINETICS OF OXIDATION OF Pr_2O_3 AND Tb_2O_3. Ramdas, S.; Patil, K. C.; Rao, C. N. R. (Indian Inst. of Tech., Kanpur).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

Isobaric oxidation studies of Pr_2O_3 and Tb_2O_3 showed the existence of several intermediate phases of composition, $PrO_{1.871}$, $PrO_{1.71}$, $PrO_{1.78}$, $PrO_{1.82}$, and $PrO_{1.833}$. The anomalous entropies of oxidation observed (−25 esu per O_2; compared with −44 esu normally found in oxidation of metals) are attributed to configuration entropy due to electronic and vacancy disorders. Activation energy for the oxidation of close-packed hexagonal Pr_2O_3 was observed to be higher than that for the fluorite-type oxide. A 4-step mechanism of oxidation is proposed. (auth)

50366 (CONF-690916-(Vol.2), pp 270-5) MULTIDENTATE AZOMETHINE COMPLEXES OF THORIUM(IV). Biradar, N. S.; Kulkarni, V. H. (Karnatak Univ., Dharwar (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

Azomethine complexes with Th(IV) were prepared by the reaction of a slight excess of azomethine with $ThCl_4$ in absolute ethanol. The complexes were found to be sparingly soluble in dimethylformamide and dimethyl sulfoxide. The elemental analysis corresponded to the composition $ThCl_2(L)_2$ where LH_2 stands for the ligand. The complexes behave as non-electrolytes in DMF. However, in view of the hexacovalency of Th(IV) these can be regarded as octahedral. The ir and electronic spectra of the complexes are discussed. (P.C.H.)

50367 (CONF-690916-(Vol.2), pp 276-8) TEMPERATURE DEPENDENCE OF FLUORESCENCE SPECTRUM IN URANYL SOLUTIONS. Bist, Hari D. (Indian Inst. of Tech., Kanpur).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

An account of the dependence of fluorescence intensity, I, on the temperature, T, of uranyl solutions is presented. The discontinuities observed in the T-I curves in the temperature range −20 to −180°C were correlated with prominent thermal transformations

taking place in these solutions. The irreversible hysteresis-type effects observed for a slow but continuous variation of temperature in the range –20 to –50°C, and the dependence of the fluorescence spectrum not only on temperature but also upon the manner in which the solution is brought to that temperature are discussed in the case of uranyl nitrate, perchlorate, and chloride solutions. (auth)

50368 (CONF-690916-(Vol.2), pp 279-82) SOME NEW COMPLEXES OF URANIUM(V) CHLORIDE. Paul, Ram Chand; Singh, Gurdev; Singh, Mangal (Punjab Univ., Chandigarh (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23–26, 1969. Vol. II.

More than fifteen new uranium(V) chloride complexes with nitrogen and oxygen bases were synthesized. With nitrogen bases, the complexes having the general formula $UCl_5 \cdot 2B$ and $UCl_5 \cdot 3B$ (B = pyridine, quinoline, isoquinoline, and α- and β-picoline). With oxygen bases such as anthrone, benzanthrone, methyleneanthrone, benzalanthrone, benzil, and dioxane, the complexes crystallize in the UCl_5 to base molar ratio of 1:1 and 1:2. Magnetic susceptibilities of the complexes from 86 to 295°K verify Curie–Weiss law with large value of θ. The ESR spectra at –196°C give G-values in agreement with those recently reported for UCl_5 complexes. The structures of the complexes are discussed in the light of ir and reflectance spectra. (auth)

50369 (CONF-690916-(Vol.2), pp 308-11) DIPHENYL SULPHOXIDE COMPLEXES OF URANYL AND THORIUM NITRATES. Ramalingam, S. K. (Madurai Univ. (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23–26, 1969. Vol. II.

Diphenyl sulfoxide(DPSO) complexes of uranyl and thorium nitrates were prepared by adding a solution of 1 g of the hydrated metal nitrate in 5 ml of methanol dropwise to a solution of about 1.2 g of DPSO in 10 ml of methanol. The solution was stirred well and allowed to crystallize under cold dry conditions. The crystals were filtered, washed with dry benzene, and dried in vacuum. Analytical results showed that the complexes have the formulas $UO_2(NO_3)_2 \cdot 2DPSO$ and $Th(NO_3)_4 \cdot 3DPSO$. Physical, analytical, cryoscopic, and conductivity data on the complexes are tabulated. (P.C.H.)

50370 MOLECULAR ARRANGEMENT, EXCITON SPLITTINGS, AND LATTICE VIBRATIONS OF CRYSTALLINE ETHYLENE. Taddei, G.; Giglio, E. (Univ., Florence). J. Chem. Phys.; 53: 2768-75(1 Oct 1970).

Molecular arrangement, vibrational splittings, and lattice frequencies were calculated for two possible monoclinic $P2_1/n$ structures of solid ethylene and deuteroethylene, using several sets of pairwise potentials of the Lennard–Jones and Buckingham type. The results show that the calculated frequencies depend strongly upon the number of the intermolecular interactions taken into account and that the attractive dispersion forces, usually neglected in previous calculations, play an important role. For very strong bands electrostatic (dipole) interactions are also of importance in the exciton splitting calculations. (auth)

50371 MATRIX-ISOLATION STUDY OF THE VACUUM-ULTRAVIOLET PHOTOLYSIS OF METHYL CHLORIDE AND METHYLENE CHLORIDE. INFRARED AND ULTRAVIOLET SPECTRA OF THE FREE RADICALS CCl, H_2CCl, AND CCl_2. Jacox, Marilyn E.; Milligan, Dolphus E. (National Bureau of Standards, Washington, D. C.). J. Chem. Phys.; 53: 2688-2701(1 Oct 1970).

Infrared and ultraviolet spectroscopic studies were conducted on the products of the vacuum-ultraviolet photolysis of normal and ^{13}C- and ^{37}Cl-labeled methyl chloride and methylene chloride isolated in argon and nitrogen matrices at 14°K. The cage effect was found to inhibit halogen detachment processes in these systems. Infrared absorptions attributable to CCl, HCCl, and H_2CCl and the 2800 Å ultraviolet absorption of CCl appear in the methyl chloride photolysis studies. Observation of a "negative anharmonicity" for the lowest-frequency infrared absorption of H_2CCl can be explained by postulating that the molecule is planar. The C–Cl stretching force constant of H_2CCl is exceptionally high. The implications of $(p-d)\pi$ bonding, which may account for the large C–Cl stretching force constant, are explored. An absorption near 2300 Å behaves appropriately for assignment to a second electronic transition of CCl, providing support for the previous tentative assignment of a group of emission bands to such a transition. Photolysis of methylene chloride in a matrix environment leads principally to the stabilization of CCl_2. A revised estimate of the force constants of CCl_2 is given. (auth)

50372 USE OF RADIOISOTOPES IN POLAROGRAPHY. NOTE VI. LIMITATIONS OF THE METHOD AS RESULTING FROM THE RADIOPOLAROGRAPHIC BEHAVIOR OF LEAD AND CADMIUM SOLUTIONS. Busulini, Loris; Bertocchi, Giovanna (Univ., Bologna. CNR, Bologna). Ric. Sci.; 39: 777-81(Oct-Dec 1969). (In Italian).

The use of radioisotopes in polarography has shown that the value of discharged radioactivity can be affected by the presence in solution of other ionic species and by the nature of the supporting electrolyte. To determine the specific radioactivity of the solutions, it is therefore advisable to verify the presence of other ions and their influence on the radiochemical data. (auth)

50373 MECHANISM OF BROMINE OXIDATIONS. II. KINETICS OF OXIDATION OF ISOBUTYRALDEHYDE BY BROMINE IN AQUEOUS SOLUTION. Kudesia, V. P. (Deva Nagri Coll., Meerut, India). Bull. Soc. Chim. Belg.; 79: 269-72(May-Jun 1970).

The kinetics of oxidation of isobutyraldehyde by bromine in aqueous solution was studied. The reaction is found to be of the first order with respect to isobutyraldehyde and first order with respect to molecular bromine. The various activation parameters have been calculated. A hydride abstraction mechanism based on the results of deuterium isotope effect was suggested. (auth)

50374 STUDY OF THE REACTION, $N_2^+ + D_2O \rightarrow N_2D^+ + OD$. Felder, W.; Sbar, N.; Dubrin, J. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-905. Chem. Phys. Lett.; 6: 385-8(15 Aug 1970).

Product (N_2D^+) angular and velocity distributions were experimentally determined over a relative energy range of 1 to 16 eV. At the lowest energy, the reaction was conclusively shown to proceed by an impulsive mode (stripping). (auth)

50375 MOLECULAR MOTIONS OF DEUTERATED ISOBUTYLENES IN THE LIQUID STATE. Assink, R. A.; Jonas, J. (Univ. of Illinois, Urbana). J. Chem. Phys.; 53: 1710-13(1 Sep 1970).

The temperature dependences of the deuteron spin–lattice relaxation times in 2-methyl-1, 1-propene-d_2 and 2-methyl-d_2-3,3,3-propene-d_3 in the liquid state were measured by the adiabatic fast passage method. Since the deuteron coupling constants were estimated from the known values for analogous systems, the experimental T_1 data were analyzed in terms of the overall reorientation of the molecules and the internal rotation of the methyl-d_3 groups. The rotational diffusion constant for overall reorientation was calculated to be $D = 0.28 \times 10^{12}$ sec^{-1} at 0°C, and the upper bound for the internal rotation rate of the methyl-d_3 groups was found to be 0.2×10^{12} sec^{-1} at 0° by assuming rotational diffusion and 0.6×10^{12} sec^{-1} at 0°C by considering random reorientation among three equivalent positions 120° apart. (auth)

50376 OXYGEN PERMEABILITY OF OXIDIZED SOLID ELECTROLYTES. Ullmann, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Z. Phys. Chem. (Leipzig); 237: 71-80(1968). (In German).

Oxygen permeability was determined for solid electrolytes comprising zirconium oxide and thorium dioxide of various compositions. Between 800°C and 1400°C an exponential relation was found between temperature and permeability. In thorium oxide, agreement of activation energy for both electric conductivity and oxygen permeability indicated a uniform direction of motion of oxide ions and defect electrons. Suitable additives changed permeability and conductivity in a parallel manner. (H.B.G.)

50377 ELECTRONIC ENERGIES AND ELECTRONIC STRUCTURES OF THE FLUOROMETHANES. Brundle, C. R. (Bell Telephone Labs., Inc., Murray Hill, N. J.); Robin, M. B.; Basch, Harold. J. Chem. Phys.; 53: 2196-2213(15 Sep 1970).

The high-resolution He I and He II photoelectron spectra of all fluoromethanes in the series CH_4 to CF_4 and their deuterated analogs have been recorded and were compared with the Koopmans' theorem results of near-Hartree–Fock calculations performed on a Gaussian basis. The agreement was very good in general and offered an unambiguous assignment of almost all of the bands observed. In particular, repeated correlations were demonstrated between the compositions of the orbitals from which the electrons were ejected and the characters of the resulting photoelectron bands. Identifiable trends throughout the series were stressed and an anomalous feature in the CF_4 spectrum was noted. Jahn–Teller effects in CH_4 and CH_3F were clearly evident, but as expected, they were not observed in CHF_3 and CF_4. Comparison of the photoelectron spectra excited with He I and He II radiation showed wide variations in the relative intensities of various bands in certain of the more symmetric molecules, suggesting that relative intensities can be a poor measure of relative orbital degeneracies. Mass-spectrometric appearance-potential data are briefly discussed in the light of the photoelectron results. The

carbon and fluorine 1s binding energies as measured with 1254-eV x rays were found to be electronically adiabatic. The accurate determination of the lower ionization potentials of these molecules led readily to the assignment of several of their electronic transitions as lower members of ns and np Rydberg series. (auth)

50378 ACTIVITY OF UO_2Cl_2 IN THE EUTECTIC LiCl–KCl MELT. Knacke, Ottmar; Krahe, Josef; Weber, Rudolf (Technische Hochschule, Aachen. Kernforschungsanlage, Juelich, Ger.). Z. Phys. Chem. (Frankfurt); 67: 194-202(Oct 1969). (In German).

From emf measurements with the cell $Mo/C/UO_2/LiCl-KCl-UO_2Cl_2//LiCl-KCl-AgCl/Ag/Mo$, the chemical potential of UO_2Cl_2 at infinite dilution in the eutectic melt and with the mole fraction as concentration mass was derived in the temperature range from 693 to 813°K as $\mu^\infty = 284{,}420 - 76.90 \cdot T$ [cal/mole]. Cell reaction and cell voltage with the exclusion of diffusion potentials were calculated for the open galvanic element by the following scheme: $\nu_1 A_1 + \ldots + \nu_\alpha e_\alpha = \nu_1 A_1 + \ldots + \nu_\beta e_\beta$; $\Sigma \nu_i \mu_i = F(\nu_\alpha \varphi_\alpha + \nu_\beta \varphi_\beta)$. In the cell reaction, in addition to the components A, the electrons e_α and e_β in both working electrodes are retained with the internal electric potential φ_α and φ_β. The chemical potentials μ_i refer to the neutral components and ions. F is the Faraday constant. (tr-auth)

50379 HETEROGENEOUS ISOTOPE EXCHANGE BETWEEN LEAD AND DISSOLVED LEAD IONS. Lieser, K. H.; Ensling, J. (Technische Hochschule, Darmstadt, Ger.). Z. Phys. Chem. (Frankfurt); 67: 233-43(Oct 1969). (In German).

By use of carefully purified, electropolished lead sheets and ^{212}Pb-labeled solutions, the heterogeneous isotope exchange between lead and dissolved lead ions under conditions of rigid oxygen exclusion was studied at six different concentrations of lead nitrate. The amount of activity dissolved from the lead sheet during the exchange research was shown to be strongly concentration dependent. The experimental results show that only a small part of the ^{212}Pb was deposited on the lead sheet by isotope exchange. Adsorption processes on the metal surfaces and the slight corrosion of the lead in the electrolyte solution under the experimental conditions were responsible for the principal part of the activity detected on the sheets. In the actual exchange, less than 0.2 atom layers of the metal surface participate; possibly no heterogeneous exchange occurs. (tr-auth)

50380 MOLAL VOLUMES OF THE ISOTOPIC HOMOLOGS OF ETHYLENE. Menes, Francis (Brookhaven National Lab., Upton, N. Y.); Dorfmueller, Thomas; Bigeleisen, Jacob. J. Chem. Phys.; 53: 2869-78(1 Oct 1970).

The molal volumes of ethylene (C_2H_4), trans-dideuteroethylene ($C_2H_2D_2$), and tetradeuteroethylene (C_2D_4) were measured over the temperature range 105 to 175°K with a precision 10^{-2}% (±0.005cm³). The order of the molal volumes is $V_{C_2H_4} > V_{C_2H_2D_2} > V_{C_2D_4}$. The difference in molal volume between ethylene and each of its deutero derivatives is approximately 0.05 $cm^3\ mol^{-1}$ per deuterium atom and decreases with temperature. The difference in molal volumes is compared with two limiting models. The size effect model, which is a consequence of the difference in lengths of the C–H and C–D bonds, leads to the correct magnitude of the difference in molal volume, but predicts $\Delta V/V$ to be temperature independent for ethylene, contrary to the experimental findings. Calculations based on an anharmonic intermolecular potential show that the hindered rotation in liquid ethylene makes a significant contribution to the molal volume difference. Finally a correlation is made between the observed molal volume differences and the measured vapor-pressure differences of the deuteroethylenes. (auth)

50381 ABSORPTION SPECTRUM OF $PuCl_3$. Carnall, W. T.; Fields, P. R.; Pappalarado, R. G. (Argonne National Lab., Ill.). J. Chem. Phys.; 53: 2922-38(1 Oct 1970).

The absorption spectrum of thin films of $PuCl_3$ was measured at 298, 77, and 4°K in the range 6000 to 34,000 cm^{-1}. Results were compared to earlier work in $LaCl_3:Pu^{3+}$, and a number of new assignments were made. Electrostatic, spin-orbit, and configuration-interaction parameters were obtained by direct diagonalization of the energy matrix and a least-squares fitting process to 30 observed levels. The variations in certain energy-level parameters within the actinide series is discussed. Intensity calculations gave only moderate agreement with oscillaor strengths of observed bands. (auth)

50382 FLUORESCENCE LIFETIME OF BENZENE AND BENZENE-d_6 VAPOR EXCITED TO SINGLE VIBRONIC LEVELS. Selinger, Benjamin K.; Ware, William R. (Univ. of Minnesota, Minneapolis). J. Chem. Phys.; 53: 3160-8 (1 Oct 1970).

The fluorescence decay curves and lifetimes of benzene and benzene-d_6 vapor were determined for excitation to each of several low-lying single vibronic levels of the $^1B_2$ state. Measurements were made at pressures as low as 0.1 torr, where the benzene system is essentially collision free, and at higher pressures of both benzene and benzene plus an added thermalizing gas. The lifetime was found to vary with the vibrational level acting as the origin for emission. The variation of the radiative lifetime with vibronic level was consistent with the predictions of Herzberg–Teller Theory for vibronically induced transition. In addition, there appears to be a deuterium isotope effect on the nonradiative decay processes. The fluorescence lifetimes obtained permit a re-examination of some of the steady-state data in the literature pertaining to the variation of the quantum yield of fluorescence with pressure. Also, inefficient electronic quenching is found when isopentane is used as a thermalizing gas. (auth)

50383 AMMONOLYSIS OF URANIUM HALIDES. PART 3. CONVERSION OF URANIUM NITRIDE HALIDES TO URANIUM MONONITRIDE. Burk, Werner; Naumann, Dieter (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Z. Chem.; 9: 189(1969). (In German).

Attempts to produce UN, important for reactor technology, failed with uranium halides and ammonia. Even at 1100°C, in vacuum, and under a highly purified argon atmosphere, UN could not be obtained. Reduction of the imido- or nitride-halides with hydrogen, however, easily resulted in the formation of UN. Above 800°C the reaction proceeded smoothly. Reduction of the chloride proved to be the most favorable process because of its stability. Beyond 1000°C the reaction proceeded very swiftly; yet, nitrogen must be avoided to prevent formation of higher nitrides. Similar procedures should be applicable for the production of nitrides of Zr, Ti, Th, Mo, and W. (H.B.G.)

50384 ELECTRODEPOSITION OF NICKEL FROM HEAVY WATER. Ammermann, F. E.; Ghosh, S.; Larson, J. A.; Lewis, C. R. (Chrysler Corp., Detroit). J. Electrochem. Soc.; 117: 1270-2(Oct 1970).

The effect of substituting deuterium for hydrogen in electroplating solutions was studied for nickel. Hydrogen evolution was much reduced in the deuterium oxide solution. The deuterium plate was relatively smooth and metallic, whereas the normal system produced a scaled and discolored surface. The anode from normal water appeared uniformly pitted but the heavy water anode was distinguished by large widely spaced holes in the surface. The deposit from the heavy water system showed more ductility and better metallurgical bond with the substrate than the deposit from normal water. A lower stress level and smaller grain size was observed in the heavy water solution. (M.C.G.)

50385 MATRIX INFRARED SPECTRUM AND BONDING IN THE MONOCHLOROMETHYL RADICAL. Andrews, Lester; Smith, David W. (Univ. of Virginia, Charlottesville). J. Chem. Phys.; 53: 2956-66(1 Oct 1970).

Simultaneous deposition of CH_2ClX (X = F, Cl, Br, I) with atomic lithium (^6Li or ^7Li) on a CsI window maintained at 15°K produced new infrared absorptions attributable to LiX and the monochloromethyl radical. The identity of the radical was confirmed by comparing the spectra of the reactions of $CHDCl_2$ and CD_2Cl_2 with lithium and CH_2ClBr with sodium. Absorptions assigned to the symmetric C–Cl stretch, the symmetric H–C–H bend, and the out-of-plane hydrogen bend of the monochloromethyl radical are supported by normal coordinate calculations. The high C–Cl force constant (4.09 ± 0.03 mdyn/Å) suggests (p–p)π bonding in CH_2Cl. The large positive quartic term in the out-of-plane bending potential function is consistent with a planar radical. (auth)

50386 EFFECT OF PRESSURE ON THE ANISOTROPIC REORIENTATION OF ACETONITRILE-d_3 IN THE LIQUID STATE. Bull, T. E.; Jonas, J. (Univ. of Illinois, Urbana). J. Chem. Phys.; 53: 3315-17(1 Oct 1970).

The deuteron and nitrogen spin–lattice relaxation times of acetonitrile-d_3 were measured as a function of pressure up to 2 kbar at 23°C using the NMR pulse method. Since the quadrupole coupling constants for nitrogen and deuterons in acetonitrile-d_3 are known, the experimental T_1 data were interpretable in terms of the rotational diffusion constants for motion perpendicular and parallel to the symmetry axis, $D_\perp$ and $D_\parallel$, respectively. In agreement with our previous results the calculated activation volumes show that $\Delta V^\ddagger$ ($D_\perp$) is much larger than $\Delta V^\ddagger$ ($D_\parallel$). (auth)

50387 APPARENT HEAT OF FORMATION OF HDO IN MIXTURES OF H_2O AND D_2O. Duer, Wayne C.; Bertrand, Gary L. (Univ. of Missouri, Rolla). J. Chem. Phys.; 53: 3020-22(15 Oct 1970).

The heats of solution of H_2O and D_2O in mixtures of H_2O and D_2O at 25°C were measured. Results are interpreted in terms of the reaction to form HDO, assuming an ideal ternary solution. The possible contributions of nonideality to the standard heat of formation of HDO(l) are considered. (auth)

50388 PLUTONIUM-DOKUMENTATION. Referate-Zeitschrift mit Anhang Transplutonium-Elemente. Juli 1970. Band 4, Heft 7. 220 Referate (Register-Nr. 2138-2562). (Plutonium-Documentation. Abstract Journal with Appendix on Transplutonium Elements. July 1970. Vol. 4, No. 7. 220 Abstracts (Register No. 2138-2562)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H (1970). 129p. (In German and English).

50389 SPECTRAL STUDIES ON SOME ORGANIC COMPLEXES OF URANYL ION. PART II. EMISSION SPECTRAL BEHAVIOR OF PYRIDINE URANYL COMPLEXES. Sanwal, D. N.; Pant, D. D. (DSB Government Coll., Nainital, India). Proc. Indian Acad. Sci., Sect. A; 71: 201-8(May 1970).

The fluorescence spectra of uranyl complexes with pyridine are described and compared with the known spectra of double salts and addition compounds. In some cases the spectra are of the double salt type, whereas in others of the type of addition compounds. The fluorescence spectra of uranyl salts are generalised into three categories: single reversal and single banded fluorescence spectrum (to which most of the uranyl salts belong), double reversal and double banded spectrum (to which uranyl sulphate trihydrate belongs), and single reversal and double banded fluorescence spectrum (to which pyridine uranyl chloride belongs). This latter situation is also found in the case of uranium-activated alkali fluoride phosphors. The decay times of these complexes are also reported. (auth)

50390 EFFECT OF VIBRATIONAL ANHARMONICITY ON THE ISOTOPIC SELF-EXCHANGE EQUILIBRIA $H_2X + D_2X = 2HDX$. Wolfsberg, Max (Univ., of California, Irvine. Brookhaven National Lab., Upton, N. Y.); Massa, Audrey A.; Pyper, J. W. J. Chem. Phys.; 53: 3138-46(15 Oct 1970).

The anharmonicity correction to the zero-point energy change in the triatomic dihydride isotopic self-exchange equilibria, $H_2X + D_2X = 2HDX$, is discussed. It is shown that the inclusion of the usually ignored term G_0 in the expression for the anharmonic correction to the zero-point energy ($G_0 + \frac{1}{4}\Sigma x_{ij}$) causes the anharmonicity correction to the zero-point energy change to be quite small for the cases considered (X is O, S, Se), but when this term is ignored the correction is found to be nonnegligible. Equilibrium constants are calculated, and it is found that the agreement between theory and experiment is considerably improved by including the G_0 factor. (auth)

50391 COLLISION-INDUCED SINGLET → TRIPLET INTERSYSTEM CROSSING OF METHYLENE AND METHYLENE-d_2. Eder, Thomas W.; Carr, Robert W. Jr. (Univ. of Minnesota, Minneapolis). J. Chem. Phys.; 53: 2258-66(15 Sep 1970).

The photolysis of ketene or ketene-d_2 in the presence of propane, oxygen, and inert gas was studied at 300°K at each of the four wavelengths 2600, 3130, 3340, and 3500 Å. Inert gases used were He, Ar, Xe, N_2, and CF_4. The inert gases caused the transition of methylene from the first singlet state to the triplet ground state. The observed kinetics of the intersystem crossing process, first order in methylene and first order in inert gas, were second order. The second-order rate constants, relative to the rate constant for reaction of singlet methylene with propane, were independent of wavelength, and increased in the order $He < Ar < CF_4 \leq Xe$. The rate-constant ratios for methylene-d_2 showed the same trend with inert gas but were 2 to 3 times larger. The results are consistent with a bimolecular intersystem-crossing mechanism where the role of the collision partner is to cause the transition to occur by sufficiently perturbing the singlet methylene stationary states. (auth)

50392 INVESTIGATION OF THE QUENCHING OF EXCITED MERCURY ATOMS BY THE ALKANES. Vikis, Andreas C.; Moser, H. C. (Kansas State Univ., Manhattan). J. Chem. Phys.; 53: 2333-42(15 Sep 1970).

The quenching of $Hg(6^3P_1)$, $Hg(6^3P_0)$, and $Hg(6^1P_1)$ by the alkanes was investigated by a theoretical model based on the formation of a relatively long-lived (Hg^*HR) complex on a potential energy surface, most likely a polar one, which leads to the quenching of Hg^* primarily by C–HHg bond rupture. The decomposition of the (Hg^*HR) complex via C–HHg bond scission was treated as a unimolecular decomposition. The potential-energy surfaces associated with the reaction coordinate were defined by thermochemical and spectroscopic data, semiempirical calculations and, whenever not critical, by reasonable estimates. The unimolecular decomposition rate constants were calculated making use of the Rice–Ramsperger–Kassel–Marcus (RRKM) theory. This approach correlates the nature and magnitude of the C–H vs C–D isotope effects and the large variation in quenching efficiencies of the various alkanes satisfactorily with the C–HHg bond strength, zero-point energy, and structural effects (vibrational degrees of freedom). Consequently, both the relative increase of the quenching cross section and the relative diminution of the effect of C–H bond strength with increasing excitation energy of the mercury atom is accounted for in terms of the relative increase in the active energies of the (Hg^*HR) molecule and its activated complex. (auth)

50393 INFRARED SPECTRA AND GEOMETRY OF MATRIX-ISOLATED DIBORON TETRACHLORIDE AND TETRAFLUORIDE; RAMAN SPECTRA OF THE LIQUIDS. Nimon, L. A.; Seshadri, K. S.; Taylor, R. C.; White, David (Univ. of Pennsylvania, Philadelphia). J. Chem. Phys.; 53: 2416-27(15 Sep 1970).

The infrared spectra of diborontetrachloride and diboron tetrafluoride molecules, isolated in a matrix of solid argon at liquid-hydrogen temperatures, along with the Raman spectra of the two compounds in the liquid phase are presented. Also reported are the $^{11}B-^{10}B$ isotopic shifts of the fundamental vibrations, which were used to establish the V_d molecular symmetry in the solid argon matrix. The Raman data also support a staggered configuration for B_2Cl_4 and B_2F_4 in the liquid phase. These data combined with the matrix infrared results were used to obtain a force constant analysis of both molecules using a Urey–Bradley force field. (auth)

50394 IS SPIN-ROTATIONAL RELAXATION EFFECTIVE IN SOLID NH_4I. Sharp, A. R.; Pintar, M. M. (Univ. of Waterloo, Ont.). J. Chem. Phys.; 53: 2428-31(15 Sep 1970).

Spin-lattice relaxation times for protons in NH_4I and deuterons in ND_4I are reported, and the dipolar and quadropolar relaxation rates are derived. In the cubic phase of NH_4I, these rates are used to analyze the frequency-independent relaxation rate of proton spins, which increases approximately exponentially with increasing temperature, with a slope of 1.5 kcal/mole. The relaxation mechanism suggested is the spin-rotational interaction. There is qualitative agreement with both the rotational diffusion and transient rotation models, which were developed for liquids. However, the strength of the spin-rotational coupling predicted by these models is some one to two orders of magnitude too weak to quantitatively reproduce the observed relaxation rate in this solid. (auth)

50395 RAMAN AND INFRARED SPECTRA OF DIMETHYLNITROSAMINE. Levin, Ira W.; Milne, G. W. A.; Axenrod, T. (National Institutes of Health, Bethesda, Md.). J. Chem. Phys.; 53: 2505-12(15 Sep 1970).

The Raman and infrared spectra of $(CH_3)_2NNO$, $(CH_3)_2N^{15}NO$, and $(CD_3)_2NNO$ were recorded in the liquid state. For $(CH_3)_2NNO$, gas-phase infrared spectra, Raman depolarization measurements, and the Raman spectra of solid polycrystalline samples were also obtained. A vibrational assignment for the 27 fundamental modes is proposed on the basis of C_s symmetry. (auth)

Radiation and Nuclear Chemistry

Refer also to abstracts 50321, 50362, 50388, 50445, 50452, 51809, 51810, 52477, 52510, 52563, and 52632.

50396 (AEC-tr-7035) FIRST NATIONAL SYMPOSIUM ON NUCLEAR CHEMISTRY, WARSAW, FEBRUARY 10–12, 1964. Translation of Nukleonika; 10: Suppl., 1-464(1965). 466p. (TT-68-50015; CONF-640210). Dep. NTIS.

An abstract for this conference, prepared from the original version, appeared as NSA 22: 4211. The numbers of the abstracts of the papers, in the same volume of NSA, are: 4049–4055, 4129–4138, 4212–4219, 4255–4260, 4275, 4421, 4468, 4494, 4626, and 4807.

50397 (CONF-690916-(Vol.1), pp 54-68) HOT ATOM CHEMISTRY: CHEMICAL CONSEQUENCES OF NUCLEAR TRANSFORMATIONS IN COBALT(III) COMPLEXES. Venkateswarlu, K. S. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23–26, 1969. Vol. I.

Studies on the chemical consequences of Szilard-Chalmers reactions in Co(III) complexes at Trombay are discussed. The general behavior regarding retention and the pattern of its subsequent increase (both by heat and radiation), has been found to be similar to that of simple substances such as chromates. This process has been designated as annealing. It was established that when solid

complexes were heated after neutron irradiation, the retention showed an increase in most cases, the increase depending on the time and temperature of heating. On the basis of values of initial retention and its increase on heating, the complexes studied were divided into two groups: octahedral complexes and open-type complexes. Differences in initial retention, isothermal annealing, and solid state exchange and mechanism of annealing between the two types of complexes are discussed. Studies on dilute systems are also mentioned. (P.C.H.)

50398 (CONF-690916-(Vol.1), pp 69-84) RADIATION CHEMICAL PROCESSING. Mani, R. S. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. I.

Radiation-chemical processing is defined and its advantages and disadvantages in industry are considered. The various types of radiation sources used in radiation-chemical processing are discussed along with the various processes initiated. The processes include radioinduced polymerization, radiation modification of polymers, radioinduced graft polymerization, radiation curing of coatings, radiation synthesis of chemicals, and material purification. Work done in India in this field is also mentioned. (P.C.H.)

50399 (CONF-690916-(Vol.2)) PROCEEDINGS OF THE CHEMISTRY SYMPOSIUM, [CHANDIGARH, SEPTEMBER 23-26, 1969]. VOLUME II. CONTRIBUTED PAPERS. (Department of Atomic Energy, [Bombay] (India). Chemistry and Metallurgy Committee). 1969. 317p.

Fifty-six articles are included; separate abstracts were prepared for 29. The remaining 27 articles contain information on: addition compounds, coordination compounds, and complexes of elements not in scope; adsorption of phosphate ions on cerium oxide; high-specific activity trace labeling of hormones and proteins; emission Moessbauer spectroscopy in ^{57}Co-doped tris-acetylacetone Mn(III); thermoluminescence of barite; self-diffusion of $H_2PO_4^-$ and SO_4^{2-} ions in 2.5% agar gel at 35°C; tracer diffusion of $H_2{}^{32}PO_4^-$ ions in different electrolyte solutions; optical electrical transport, and dielectric studies on rare earth perovskites; kinetics of oxidation of N,N-dimethylformamide with ceric ammonium nitrate; and ir spectra of rare earth compounds. (P.C.H.)

For abstracts of individual papers see: 50337-50339, 50353, 50355, 50365-50369, 50400-50410, 50437, 50444-50448, 50465, and 50517.

50400 (CONF-690916-(Vol.2), pp 144-9) EFFECT OF ELECTRIC FIELD AND IRRADIATION ON THE TRACER DIFFUSION OF ALKALI EARTH IONS THROUGH CALCITE. Arnikar, H. J.; Chaure, B. D. (Poona Univ. (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

The effects of gamma irradiation (2 to 3 Mrads) and external field (27 to 100 V/cm) on the diffusion of alkali earth ions in single calcite crystals at 300°C were studied by tracer techniques. The results showed that the diffusion coefficient of ions studied decreased in irradiated crystals. It was further observed that when diffusion rates were determined on irradiated crystals after subsequent bleaching, the D values approached the initial values observed in the irradiated crystal. The results of electrodiffusion at various field strengths indicated that D-values in the direction of field were higher (10 to 40%) than in the reverse direction. (auth)

50401 (CONF-690916-(Vol.2), pp 174-9) EVEN ELECTRON SPECIES IN THE γ-RADIOLYSIS OF LIQUID HYDROCARBONS. Mittal, Jai P. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

An attempt has been made to determine the importance of positive ion intermediates of even electron configurations (such as carbonium ions) in the γ radiolysis of hydrocarbons. These even electron species (carbonium ions) have been counted by derivatizing them with a suitable negative species X produced in situ. G-values for various primary and secondary hydrocarbons were much less than for tertiary and branched hydrocarbons. The very interesting observation that the trend of the production of these carbonium ions runs parallel to the values obtained for "free ions" (obtained by conductivity measurements) for various hydrocarbons, indicated that the explanation of different values (structure dependent) of "free ion" yield may be correlated with their carbonium ion yields obtained from γ radiolysis of the respective hydrocarbons. (auth)

50402 (CONF-690916-(Vol.2), pp 180-5) PULSE RADIOLYSIS END PRODUCTS IN ALLYL BROMIDE-CYCLOHEXANE SYSTEM. Bhattacharyya, P. K.; Burrell, E. J. Jr. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

The electron pulse radiolysis end products of allyl bromide solution in cyclohexane medium have been studied by gas liquid partition chromatography. The quantitative estimation of cyclohexyl bromide, 1,5-hexadiene, cyclohexene, and dicyclohexyl was carried out. The primary and secondary reaction mechanisms have been proposed on the basis of the product analysis and the free radical scavenger study of the system. Thus, the formation and decay of the allyl radical in the system is explained. The molar extinction coefficient of the allyl free radical was determined to be 2.93×10^3 M^{-1} cm^{-1}, which is slightly higher than the reported value. (auth)

50403 (CONF-690916-(Vol.2), pp 186-95) THE NATURE OF THE MOBILE AND TRAPPED SPECIES FORMED DURING THE γ-RADIOLYSIS OF FROZEN SYSTEMS. Moorthy, P. N. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

Recent experimental findings indicated that primarily formed electrons and holes in the radiolysis of frozen systems were mutually correlated. The familiar solid state physics concept of the exciton has been applied to understand the nature of these correlated hole-electron pairs, and it is suggested that they can be regarded as "polar excitons". Under certain conditions, the mobile reactive species can be trapped in the matrix, and it seems plausible that the trapped species is an electron bound in the field of a secondary ion formed by an ion-molecule reaction of the primary positive hole with the matrix. (auth)

50404 (CONF-690916-(Vol.2), pp 196-9) HOMOGENEOUS KINETICS MODEL OF AQUEOUS RADIOLYSIS. Gopinathan, Chakrapany (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

A possible alternative model for the formation of molecular products in aqueous radiolysis has been proposed. The interaction of two tightly bound or Frenkel excitons leads to the formation of H_2 and H_2O_2. The excitons can arise from the neutralization of electron or from the reaction $H_3O^+ + OH^- \rightarrow 2H_2O$. The present model differs from the earlier homogeneous kinetic models in assuming a second order reaction for the formation of molecular products. (auth)

50405 (CONF-690916-(Vol.2), pp 200-4) RADIATION DECOMPOSITION OF COBALT HEXAMINE NITRATE IN SOLID MATRICES. Srivastava, S. B.; Sarpotdar, A. S. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

The gamma radioinduced decomposition of cobalt hexamine nitrate dispersed in solid halide matrices has been studied. It has been found that the decomposition of the complex in the mixture is an order of magnitude greater than that obtained for the pure complex in the dose range $\approx 10^5$ to 10^7 R. The magnitude of decomposition followed the order KCl < KBr < KI and has been found to be strongly dependent on the degree of aggregation and the temperature of irradiation. The results have been explained in terms of charge localization on the complex molecule. (auth)

50406 (CONF-690916-(Vol.2), pp 205-11) RADIOLYSIS OF SOLUTIONS CONTAINING TRIS(ACETYLACETONATO) COBALT(III) IN DIFFERENT SOLVENTS. Rao, K. V. S. Rama; Sapre, A. V.; Shastri, L. V. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

The radiolytic reduction of tris(acetylacetonato) cobalt(III) was studied in solutions of water, 2-methyl tetrahydrofuran, cyclohexane, and benzene. In some cases the reduction product was identified as bis(acetylacetonato) cobalt(II) from absorption spectral data. The efficiency of this complex as an electron/ion-pair scavenger in these solvents has been examined. The rate constants for the reaction of hydrated electrons and hydrogen atoms were determined by competition kinetics in aqueous solutions. (auth)

50407 (CONF-690916-(Vol.2), pp 212-18) OXIDISED PRODUCT YIELDS IN THE GAMMA RADIOLYSIS OF FROZEN GLASSY SULPHURIC ACID. Gopinathan, Chakrapany (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

Oxidized products produced by the gamma radiolysis of frozen, 5M sulfuric acid at 77°K have been measured. It was found that the major oxidized products were the peracids. The yield of hy-

drogen peroxide was very low in degassed 5M H_2SO_4 and was even lower in the undegassed acid. The low yield of hydrogen peroxide has been confirmed by the radiolysis of this system in the presence of Ce^{4+}. The results were interpreted using the concept of excitons and the possible absence of any genuine "spurs". (auth)

50408 (CONF-690916-(Vol.2) pp 219-21) HYDROGEN PEROXIDE YIELDS IN γ-RADIOLYSIS OF DEAERATED CYSTEINE SOLUTIONS. Lal, Manohar (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

Studies on the γ radiolysis of deaerated cysteine solutions established that the reaction $2CySH + H_2O_2 \rightarrow (CyS - SCy) + 2H_2O$ can be dropped from the reaction scheme for the radiolysis of cysteine. G-values for hydrogen peroxide and cysteine as calculated from the slope of the straight lines obtained from yield–dose plots are tabulated. (P.C.H.)

50409 (CONF-690916-(Vol.2), pp 222-6) (n,γ) RADIOLYSIS OF SOLID IODIC ACID. Arnikar, H. J.; Dedgaonkar, V. G.; Shrestha, Kamal K. (Poona Univ. (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

The distribution of ^{128}I between I^- and IO_3^- states following neutron capture by ^{121}I in solid iodic acid has been investigated (using an Sb–Be neutron source). The effects of subsequent annealing were similar to those with other salts containing oxyanions. The retention has been studied as a function of irradiation and annealing temperatures. The results are discussed. The effects of pre-irradiation gamma dose and gamma annealing were also studied. The results of studies on aqueous iodic acid are also mentioned. (auth)

50410 (CONF-690916-(Vol.2), pp 227-38) ISOTOPE EFFECT AND SECONDARY REACTIONS OF RECOIL ^{82}Br AND ^{80m}Br ATOMS UNDER (n,γ) PROCESS IN ALKYLBROMIDES. Mishra, S. P.; Shukla, B. M. (Banaras Hindu Univ., Varanasi (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

An isotope effect has been observed in bromoalkanes. Several alkyl bromides were subjected to neutron irradiation in the liquid phase at varying concentrations of bromine scavenger. The details of the findings on propylbromides are given. The role of high energy and diffusive processes are considered in detail. The analysis of the neutron irradiation products of propyl bromides is also described The results are discussed in the light of the present ideas. (auth)

50411 (COO-1763-16) PULSE RADIOLYSIS STUDIES OF FAST REACTIONS IN MOLECULAR SYSTEMS. Annual Progress Report, August 19, 1969–August 27, 1970. Dorfman, Leon M. (Ohio State Univ., Columbus. Dept. of Chemistry). Contract AT-(11-1)-1763. 4p. Dep. CFSTI.

Absolute rate constants at 25°C for the addition reaction of H atoms, produced by the electron pulse radiolysis of gaseous hydrogen, with O_2, CO, NO, and ethylene, and the relative third-body efficiencies of hydrogen and argon in these reactions were determined. The optical absorption band of the solvated electron produced by the electron pulse radiolysis of a weakly polar liquid, tetrahydrofuran(THF), was studied to wavelengths beyond 20,000 Å at room temperature using a fast infrared detection system. The absorption maximum in THF was found to be 2.1 ± 0.1μ. (J.G.B.)

50412 (KURRI-TR-62) PROBLEMS RECENTLY ENCOUNTERED IN RADIATION CHEMISTRY. Yoshida, Hiroshi (ed.) (Kyoto Univ. (Japan). Research Reactor Inst.). 1969. 23p. (In Japanese). (CONF-681230-(Absts.)). Dep. NTIS (U. S. Sales Only).

Abstracts of four papers delivered at the research conference on "Various Problems Recently Encountered in Radiation Chemistry" held on December 23, 1968 at the Research Reactor Institute of Kyoto University are presented. The first paper discusses electrons in condensed phases which treats the subjects of the G-value of electron (hydrated) formation, size of the tracks, diffusion theory, and ion reactions. The second paper considers the application of cyclotron resonance to chemical reactions and associated problems. The advantages and problems associated with Moessbauer spectroscopy are discussed in the third paper. The subject of the final paper is radiation chemistry at very low temperatures. It reviews earlier work done and discusses the problems associated with the radioinduced polymerization of acrylamide. The problem of trapped electrons in organic glasses is also considered. (TTT)

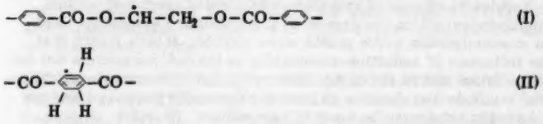
50413 (ORO-3602-11) REACTIONS OF CHARGED AND NEUTRAL RECOIL PARTICLES FOLLOWING NUCLEAR TRANSFORMATIONS. Progress Report No. 4. Ache, Hans J. (Virginia Polytechnic Inst., Blacksburg. Dept. of Chemistry). Sep 1970. Contract AT(40 1)-3602. 6p. Dep. CFSTI.

50414 PHOTOCONDUCTIVITY IN γ-IRRADIATED ALKALINE ICE. Eisele, Ignatz; Kevan, Larry (Wayne State Univ., Detroit). J. Chem. Phys.; 53: 1867-76(1 Sep 1970).

The photoconductivity due to radioinduced trapped electrons in glassy alkaline ice (10M NaOH) at 77°K has been studied. The temperature dependence of the photocurrent from 4 to 120°K and the coincidence of the wavelength dependence of the photocurrent with the absorption band show that no stable bound excited state exists for the trapped electron. The relation of this result to the importance of short-range interactions in electron binding is discussed. It was also found that radioinduced shallow traps for electrons were formed. These traps had an average depth of 0.048 eV and appeared to be associated with a lattice distortion created by the presence of O^-. Both Ohmic and super-Ohmic currents were found under certain conditions. The super-Ohmic current was interpreted as due to a voltage-dependent lifetime of conduction band electrons. (auth)

50415 POST-IRRADIATION FREE-RADICAL REACTIONS IN POLY(ETHYLENE TEREPHTHALATE). Campbell, D.; Monteith, L. K.; Turner, D. T. (Research Triangle Inst., Research Triangle Park, N. C.). J. Polym. Sci., Part A-1; 8: 2703-11(Sep 1970).

Exposure of poly(ethylene terephthalate) to γ rays resulted in the formation of radical I, radical II (tentatively), and to an unassigned radical (III) which is responsible for a



(I)

(II)

central peak in the ESR spectrum. It is believed that completely amorphous samples of polymer contain radicals II and III. On heating, the radicals decayed, and the relative proportion of radical III increased. The kinetics of the overall decay process were followed by measuring the decrease in peak height with time. After an initially rapid reaction the decay of the radical population conformed to second order kinetics. An Arrhenius plot of the logarithm of specific rate versus 1/T indicated two lines which intersected at 72°C, which was close to the glass transition temperature. The activation energies were 112 kcal mole above 72° and roughly 25 kcal/mole below 72°C. Reference to reports in the literature suggests that this decay can be explained by long-range movement of the polymer molecules, even in the glassy solid. The decay of radical I in the crystalline regions of an oriented sample was found to follow first-order kinetics. As the decay occurs at temperatures as low as 100°C (the melting point was about 260°C), it seemed that decay by normal physical movement is unlikely. The results might be explained by invoking the hypothesis of chemical migration of free radical sites by hydrogen atom hopping. (auth)

50416 RADIATION-INDUCED OXIDATION OF ALCOHOLS BY Tl(III) IN ACID AQUEOUS SOLUTION. Burchill, C. E.; Hickling, G. G. (Univ. of Manitoba, Winnipeg). Can. J. Chem.; 48: 2466-73(15 Aug 1970).

In deaerated aqueous perchloric acid solution Tl(III) was reduced and 2-propanol oxidized to acetone in essentially equivalent yields by a γ-induced chain reaction. The yields increased linearly with increasing alcohol concentration in the range (1 to 8) × 10^{-2} M, were independent of Tl(III) concentration in the range (1 to 4) × 10^{-3} M and varied inversely with the square root of the dose rate over the range 1.6×10^{17} to 1.8×10^{19} eV l^{-1} s^{-1}. A mechanism is proposed to account for the observed stoichiometry and kinetic parameters. The same mechanism was found to apply to the reduction of Tl(III) by methanol and ethanol. t-Butyl alcohol gave a much lower yield of Tl(III) reduction and alcohol fragmentation products: acetone, methane, and ethane. (auth) (Canada)

50417 CHEMICAL EFFECTS OF NEUTRON IRRADIATION OF α-TRIFLUOROTOLUENE. Ledrut, J. H. T. (Centre de la Faculte Polytechnique, Mons, Belgium). Radiochim. Acta; 14: 55-6(1970). (In French)

Measurement was made of α, α, α-trifluorotoluene remaining after 14-MeV neutron irradiation of pure α, α, α-trifluorotoluene and α, α, α-trifluorotoluene in HF or ethanol and acetic acid solutions. Beta emission from ^{18}F was determined by scintillation counting. (J.G.B.)

50418 RADIOLYSIS OF MIXTURES OF SATURATED AND AROMATIC FLUOROCARBONS. Khramchenkov, V. A. This

paper was summarized in At. Energ. (USSR); 25: 423-4(Nov 1968) as paper No. 242. (In Russian).

It was previously reported (V. A. Kramchenko, At. Energ., 21: 375(1966)) that perfluorinated benzene, which is more inclined to radiation polymerization than its hydrogen analog, exerts an inhibiting effect in the radiolysis of perfluorocyclohexane. In the radiolysis of n-C_9F_{20}, however, perfluorinated benzene initiates the formation of polymer products. It was subsequently discovered that perfluorinated diphenyl also exerts a polymerization-initiating effect in the radiolysis of n-C_9F_{20}, as well as C_6F_6, as a result of the action of n,γ-radiation of a nuclear reactor (irradiation was performed in glass ampoules, temperature of irradiation ~50°C, doses of 60 and 75 Mrad, respectively). In the radiolysis of perfluoroorthodimethylcyclohexane (dose 90 Mrad), however, perfluorodiphenyl, just as in the case of a mixture of C_9F_{12} with C_6F_6, produced an inhibiting effect. The cause of the observed effects may be a tendency of the fluorocarbon radicals and molecules to form conjugated systems, which are manifested in radiation isomerization of C_6G_6, leading to the formation of a Dewar structure, as well as hexafluorobicyclo[2.2.0]hexa-2,5-diene, possessing diene properties. In the radiolysis of perfluorinated alicyclic compounds with perfluorinated aromatic compounds, apparently there is an energy transfer. (auth)

50419 HERBICIDE EFFECTS OF SODIUM TRI-CHLOROACETATE PRODUCED BY RADIOCHEMICAL METHOD. Dzeeva, V. P.; Mashtakov, S. M. Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk; No. 3, 61-7(1970). (In Belorussian).

Herbicidal effects of radiation-chemically produced sodium trichloroacetate on the growth of dicotyledon, Lupinus sp., and on monocotyledon grain plants were studied. It was shown that the influence of radiation-chemically prepared compounds did not differ from that of the compounds prepared by conventional chemical methods and that the radiation-chemically prepared sodium trichloroacetate can be used in agriculture. (R.V.J.)

50420 RADIOLYSIS OF AQUEOUS 2,2,2-TRIBROMOETHANOL SOLUTIONS. Sorensen, V. G.; Bhale, V. M.; McCallum, K. J.; Woods, R. J. (Univ. of Saskatchewan, Saskatoon). Can. J. Chem.; 48: 2542-7(15 Aug 1970).

Hydrogen bromide, glycolic acid, and carbon dioxide were identified as products of the γ radiolysis of aqueous 2,2,2-tribromoethanol solutions. The effects of oxygen, tribromoethanol concentration, and dose rate upon the yields of bromide ion and acid were determined, and partial radiolysis mechanisms are proposed for reaction in the presence and absence of oxygen. Dibromoacetaldehyde, reported to be a product of the photochemical decomposition of tribromoethanol solutions, was not detected in the radiolysis experiments or in tribromoethanol solutions exposed to sunlight. (auth) (Canada)

50421 PRODUCTION OF RADIOISOTOPES BY SPALLATION. Stang, L. G. Jr.; Hillman, M.; Lebowitz, E. (Brookhaven National Lab., Upton, N. Y.). Isotop. Radiat. Technol.; 8: 1-12(Fall 1970). (BNL-50195(T-547)).

The discussion is intended to provide a practical basis for planning to produce radioisotopes by spallation. For this purpose, extensive tabulations of calculated yields of products from virtually every possible target element bombarded by 200-MeV protons are included. In addition, the effects of bombarding energy and choice of target on product yield are examined. Several advantages of the spallation process relative to fission are enumerated. The thin-target spallation cross-section formula that was derived empirically by Rudstam was used. Examination of this formula shows that, for a given nuclide ${}_ZL^A$ (where Z = atomic number and A = mass number) produced from a given target of mass A_t, the spallation cross section goes through a maximum when the bombarding particle energy, E, is around 100 MeV. However, when thick targets are considered and the accompanying attenuation of beam intensity is taken into account, an incident particle energy of 200 MeV is shown to be a good practical compromise between the unmanageably thick targets that would be required for efficient use of much higher energy particles and the decreased product activity that would be encountered at lower bombarding energies. In this connection, the axial distributions of a typical product activity along the beam path in a thick target are shown graphically for 800- and 200-MeV incident protons. In addition, the yields of unwanted by-products are shown to be many times as great at 800 MeV as at 200 MeV. For a given E, the yield of ${}_ZL^A$ increases as A_t approaches A. The yield in millicuries of ${}_ZL^A$ from a thick target is described by an equation that contains a suitable correction for the variation of spallation cross section with (decreasing) energy as the bombarding particle traverses the thick target. The equation applies to bombardments by protons, neutrons, deuterons, or alpha particles, provided that the appropriate ranges of the respective particles are used. The accuracy of the results is commensurate with that of the Rudstam formulation (i.e., within a factor of 3 of experimentally determined values, where such a comparison could be made). This equation was programmed for computer solution, and tabulated results show the independent yields produced by a 200-μA beam of 200-MeV incident protons bombarding for 24 hr targets that ranged from lithium to uranium. The data are arranged in tabular form by product desired and also by target used. The activities of the radioactive products (with half-lives greater than 1 min) as well as the production cross sections of both radioactive and stable products are also tabulated. (auth)

50422 RADIATION GRAFTING ON COTTON TEXTILES AND FIBERS. Hoffman, Allan S. (Massachusetts Inst. of Tech., Cambridge). Isotop. Radiat. Technol.; 8: 84-95(Fall 1970).

A review is given on two areas that have had the greatest recent impact on commercial application of radiation in textiles: crease recovery (or permanent press) and surface modification of wetting properties such as soil and stain release, with particular regard to cellulosic materials. (53 references). (P.C.H.)

50423 EXCITATION AND SUPEREXCITATION OF ELECTRON STATES OF ATOMS AND MOLECULES AND THEIR ROLE IN RADIATION CHEMISTRY (REVIEW). Makarov, V. I.; Polak, L. S. (Inst. of Petrochemical Synthesis, Moscow). Khim. Vys. Energ.; 4: 1-23(Jan-Feb 1970). (In Russian).

The superexcited state of molecules is the state in which the energy of electron excitation exceeds the first ionization potential of the molecule. Autoionization and predissociation of superexcited states are examined. The superexcited state may be either dissociated or ionized; it may be reached by the simultaneous excitation of two electrons or by the excitation of one of the internal electrons at one of the upper molecular orbitals. The probability of the formation of this state for the case of alkanes with an energy below the ionization potential is reviewed, describing experiments which reveal superexcited states. Coincidence of scattered and knocked-out electrons in the interaction of monochromatic electron and molecular beams and spectrometric techniques are used for the quantitative study of superexcited states. The role of these states in the chemistry of high-energy particles and for radiation chemistry is outlined. (101 references.) (TTT)

50424 MAGNETIC RESONANCE STUDIES OF METAL-OLEFIN COMPLEXES. I. ELECTRON SPIN RESONANCE SPECTRA OF γ-IRRADIATED SILVER PERCHLORATE CYCLOALKENE COMPLEXES. Gee, D. R.; Russell, K. E.; Wan, J. K. S. (Queen's Univ., Kingston, Ont.). Can. J. Chem.; 48: 2740-4(1 Sep 1970).

Paramagnetic species were detected in γ-irradiated polycrystalline silver perchlorate–cycloalkene complexes at room temperature and identified as Ag^+ cycloalkenyl radicals, with spin density on Ag decreasing from 4.6 to 1.5% with increasing size of the cycloalkenyl ring. The extent of the spin density on Ag increases with the stability of the parent complexes. (auth) (Canada)

50425 BLUE RADIOLUMINESCENCE OF LEAD CHLORIDE SINGLE CRYSTALS AT LOW TEMPERATURES. Czegledy, Sandor; Karvaly, Bela; Pinter, Ferenc. ATOMKI (At. Kut. Intez.) Kozlem.; 12: 1-3(Jun 1970). (In Hungarian).

Lead chloride single crystals show a blue radioluminescence at low temperatures. The temperature dependence of this effect is discussed. (auth)

50426 SPIN-QUENCHING BY OXYGEN OF A RADIOSENSITIZING NITROXIDE FREE RADICAL IN AQUEOUS SOLUTION. Jones, W. B. G.; Brustad, T.; Nakken, K. F. (Norsk Hydro's Inst. for Cancer Research, Oslo). Int. J. Radiat. Biol.; 17: 591-3(1970).

Results of an ESR study of 2,2,6,6-tetramethyl-4-piperidone 1-oxide (TAN) indicated that TAN would become covalently bonded to OH-induced DNA transients under anoxic conditions, whereas no binding would occur when irradiation is performed in the presence of oxygen. The observed spin-quenching of TAN by oxygen appeared to be reversed by subsequent nitrogen bubbling. (UK)

50427 PULSE RADIOLYTIC INVESTIGATION OF THE KINETICS OF DIFFUSION-CONTROLLED REACTIONS OF OH RADICALS WITH POLYMERS AND OLIGOMERS IN AQUEOUS SOLUTIONS. Behzadi, A.; Borgwardt, U.; Henglein, A.; Schamberg, E.; Schnabel, W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Ber. Bunsenges. Phys. Chem.; 74: 649-53 (Jul 1970). (In German).

The rate constants of the reactions of the OH radical produced by the electron-pulse radiolysis of polyethylene oxide, polyvinyl-

pyrrolidone, and dextran were measured as functions of chain length and polymer concentration. The OH radical reaction with these polymers is practically diffusion controlled. At low concentrations ($<10^{-2}$ base mole liter^{-1}), the rate constant k_M (in mole^{-1} liter sec^{-1}) is proportional to n^b and the rate constant k_m (in base mole^{-1} liter sec^{-1}) is proportional to n^{b-1} (n: chain length, b: exponent of the relation $\bar{h} \sim n^b$ for the mean end to end distance $\bar{h}$). At high concentrations (>0.5 base mole liter^{-1}), k_M is proportional to n and k_m independent of n. In the experiments with polyethylene oxide oligomers with $n > 2$ were also investigated. When n is smaller than 50, deviations from the relation $k_M \sim n$ are observed which are explained by the smaller shielding of inner base units in the polymer coils. The trimer of polyethylene oxide behaves as a low-molecular-weight compound with concentration independent rate constant. (auth)

50428 ENQUIRY INTO THE PURITY OF COMMERCIAL RADIOCHEMICALS. Pure Appl. Chem.; 21: 85-90(1970).

The self-decomposition of labelled compounds is discussed. Dissatisfaction with these compounds resulted in the production of a questionnaire, sent to 66 laboratories in 18 countries to which there was a 60% response. An unacceptable level of impurities was reported in 70% of the answers, and tritium-labelled compounds were found in general to be worse than the C_{14} analogues. Impurities caused by self-radiolysis and by poor purification could not be distinguished. No one class of compounds was reported to be clearly worse than another. It is recommended that all users of radioactive compounds analyze their shipments and improvement is hoped for. (UK)

50429 RADIATION-INDUCED COPOLYMERIZATION OF TETRAFLUOROETHYLENE AND 3,3,4,4,5,5,5-HEPTAFLUORO-PENTENE-1 UNDER PRESSURE. Brown, Daniel W.; Lowry, Robert E.; Wall, Leo A. (National Bureau of Standards, Washington, D. C.). J. Polym. Sci., Part A-1; 8: 2441-52(Sep 1970).

An investigation was made of the γ-ray-induced copolymerization of tetrafluoroethylene and 3,3,4,4,5,5,5-heptafluoropentene-1. At 22°C at 5000 and 10,000 atm the polymerization rate changed little between 0 and 75 mole % tetrafluoroethylene. Above 90 mole % the rate increased greatly. Molecular weights varied with composition in a fashion similar to the variation of the rates. Crystallization occurred in the bulk pentene at 13,500 atm at 24°C. The polymerization rate was very low in the solid state. Under some conditions polymerization continued long after irradiation was ended. Both reactivity ratios favored the pentene. Several copolymer properties were studied. The polymers were amorphous and soluble in perfluoro ethers, perfluoro alkanes, and perfluoroaromatics if they contained less than 80% tetrafluoroethylene. The glass temperatures of the amorphous polymers decreased and the thermal and radiation stability increased as the tetrafluoroethylene content increased. (auth)

50430 UNSTABLE INTERMEDIATES. PART LXXV. ELECTRON SPIN RESONANCE STUDIES OF THE EFFECT OF ENVIRONMENT UPON THE HYPERFINE PARAMETERS FOR PO_3^{2-} AND NO_3^{2-}. Symons, M. C. R. (Univ. of Leicester, Eng.). J. Chem. Soc., A; No. 11, 1998-2000(1970).

The radicals PO_3^{2-} and NO_3^{2-}, formed in a variety of solids on exposure to high-energy radiation, have hyperfine parameters (^{31}P and ^{14}N) which are strongly dependent upon the nature of the host crystal. The results, which were analysed in terms of s- and p-orbital contributions, show that for PO_3^{2-}, the spin-density is strongly dependent upon the medium, with the p to s ratio increasing slightly as the spin-density on phosphorus falls. However, the spin-density on ^{14}N in NO_3^{2-} is almost independent of the environment, but the p to s ratio is very sensitive to it. These results are discussed in terms of the trends observed within the isoelectronic families of these two radicals. (auth) (UK)

50431 CHEMICAL EFFECTS OF THE $^{80m}Br \rightarrow {}^{80}Br$ ISOMERIC TRANSITION IN SODIUM BROMATE. Jones, C. H. W. (Simon Fraser Univ., British Columbia). Radiochim. Acta; 14: 1-10 (1970).

Chemical effects of the $^{80m}Br \rightarrow {}^{80}Br$ isomeric transition were studied in sodium bromate crystals labeled with ^{80m}Br, and in $^{80m}Br(n,\gamma)$ and (n,2,) recoil sites in neutron-irradiated crystals. The retentions observed at room temperature and the thermal annealing reactions of the isomeric transition daughter in these three systems are reported. The results are discussed in terms of the factors influencing the nature of the recoil site produced in the different nuclear transformation sequences. (auth)

50432 ESR STUDIES OF DEUTERATED dl-TARTARIC ACID X IRRADIATED AT 195°K. Moulton, Grace C.; Cernansky, Barbara (Florida State Univ., Tallahassee). J. Chem. Phys.; 53: 3022-5(15 Oct 1970).

Using electron spin resonance techniques, the free radical produced when single crystals of deuterated dl-tartaric acid are irradiated at 195°K with either 50kV or 3-meV x rays was found to be ·CHODCHODCOOD·D_2O. The C–C bond to the carboxyl group is broken and the unpaired electron is primarily in a 2pπ orbital on the carbon atom with the p orbital close to the normal to the carbon plane. This results in a hyperfine coupling to two H atoms with eigenvalues of −33.4, −23.0, −10.7 G for the α-H hydrogen, and 37.2, 35.8, 30.5 G for the β−H. This radical is the same radical that is observed if deuterated dl-tartaric acid is irradiated at 77°K and allowed to warm to 195°K. This radical follows the decay of the cation radical produced at 77°K and subsequently decays to the stable room temperature radical. The anion radical which was observed at 77°K is still present at 195°K. (auth)

50433 HYDRAZINE-LIKE DEFECT, $N_2H_4^+$, IN IRRADIATED AMMONIUM HALIDES. II. THEORETICAL ANALYSIS. Reilly, M. H.; Marquardt, C. L. (Naval Research Lab., Washington, D. C.). J. Chem. Phys.; 53: 3257-65(15 Oct 1970).

An LCAO–MO energy level diagram and bond length estimates were used to describe a planar ethylenic molecule model for the $N_2H_4^+$ defect at an NH_4^+ site in ammonium halides. The unpaired spin orbital is an antibonding combination of 2p orbitals on each nitrogen perpendicular to the molecular plane. The model is then further specified and used to analyze the low-temperature EPR data for NH_4Cl in detail, from which hyperfine, bond length, and bond angle parameters were extracted and compared with LCAO–MO calculations. More information about the defect and confirmation of the model were obtained. Satellite intensity and linewidth angular variations in the high-temperature spectra are explained, and the relation of high- to low-temperature spectra discussed. (auth)

50434 TRAJECTORY STUDIES OF HOT-ATOM REACTIONS. I. TRITIUM AND METHANE. Bunker, Don L.; Pattengill, Merle D. (Univ. of California, Irvine). J. Chem. Phys.; 53: 3041-9(15 Oct 1970).

The reactions of $T + CH_4$ and $T + CD_4$ were studied, treating these as six distinct particles, using a variety of potential energy surfaces subject to the restriction that only one methane hydrogen at a time is reactive. The principal findings are: (1) this trial assumption about the potential is unjustified. Substitution (products $CH_3T + H$ and $CD_3T + D$) involves strong interactions between at least four atoms. (2) There were no inertial isotope effects of any kind when CH_4 was replaced by CD_4. (3) From (2) and the details of the trajectories, there is suggestive but not conclusive evidence that substitution in CH_4 proceeds by Walden inversion. (4) Abstraction (products $CH_3 + HT$ and $CD_3 + DT$) is direct and concerted and occurs at relatively low energy. In the calculations it had a maximum cross section of 3.5 Å^2 for a reactant translation energy of 65 kcal. At sufficiently high energy it is a stripping reaction. (5) About half the abstraction product energy is translational; the remainder appears as internal energy of both HT and CH_3. When substitution occurs as a three-centered process, it deposits about 70 kcal in CH_3T. Fragmentation is an important process above 100-kcal reactant energy. (auth)

50435 HYDRAZINE-LIKE DEFECT, $N_2H_4^+$, IN IRRADIATED AMMONIUM HALIDES. I. PRODUCTION AND CHARACTERIZATION. Marquardt, Charles L. (Naval Research Lab., Washington, D. C.). J. Chem. Phys.; 53: 3248-56(15 Oct 1970).

The hydrazine-like defect in irradiated ammonium halides was studied using electron paramagnetic resonance. The results suggest that this defect is an $N_2H_4^+$ molecular ion at a normal ammonium ion lattice site. In NH_4Cl and NH_4Br it freezes in the lattice in such a way that the p orbitals in which the unpaired spin is localized are aligned along a ⟨110⟩ direction. The defect appears to be produced as a result of chemical decomposition of NH_3X centers (X = halogen) through the competitive processes: $NH_3X \rightarrow NH_4^+ + X^- + H^0$ and $NH_3X \rightarrow NH_3^+ + X^- + H^+$. Products of these reactions then combine to form $N_2H_4^+$ in the following way: $NH_4^+ + NH_3^+ \rightarrow N_2H_4^+$. The $N_2H_4^+$ subsequently undergoes decomposition at higher temperatures, its stability at any given temperature being also influenced by impurities. (auth)

Radiochemistry

Refer also to abstract 50431.

50436 (ANL–7642) INTERNATIONAL COMPARISON OF ^{56}Mn ACTIVITY IN 1968. DeVolpi, A. (comp.) (Argonne National Lab., Ill.). Dec 1969. Contract W-31-109-eng-38. 34p. Dep. CFSTI.

The absolute radioassay of liquid samples of ^{56}Mn was carried

out by six laboratories in Europe and North America in September 1968. Aside from frequent application in a variety of nuclear reactor irradiations, ^{56}Mn is the basic activity produced in the manganese bath system of neutron-source calibration, which in turn is directly connected with some determinations of the neutron yield from fission. Because of possible related discrepancies in nuclear data, a limited intercomparison was organized by the National Physical Laboratory of England. Although the 2.6-hr half-life places a premium on rapid transportation and processing, six laboratories were able to participate simultaneously. All participants calibrated aliquots of the samples through a coincidence technique. The range of values obtained was 0.6%, and the rms error was 0.1%. Despite the narrow range of results, a bias due to calibration technique is possible. The 4π liquid-scintillation/gamma-coincidence method appears to yield disintegration values about 0.3% higher than the 4π proportional-counter gamma-coincidence technique; however, use of a half-life 0.2% lower than the reference value of 2.578 hr eliminates part of this apparent bias in counting method. The coincidence data computer program COINC was also tested and found to produce results consistent with data-processing formulas applied at the other laboratories. (auth)

50437 (CONF-690916-(Vol.2), pp 112-17) STUDIES ON THE STABILITY AND SHELF-LIFE OF SOME LABELLED RADIOPHARMACEUTICALS. Desai, C. N.; Mani, R. S.; Prabhu, T. P. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

Stability studies of radiopharmaceuticals, especially those labeled with radioiodine, such as Rose Bengal, Hippuran, fats, serum albumin, and thyroid hormones, have been carried out using paper chromatography and paper electrophoresis. It has been observed that the main impurity arising during the storage is free iodine. Based on these data, optimum specifications and shelf-life have been laid down. (auth)

50438 CHEMICAL CONSEQUENCES OF THE ISOMERIC TRANSITION $^{133m}Xe \rightarrow {}^{133}Xe$ IN XENON TRIOXIDE. Heitz, Ch.; Cassou, M. (Centre de Recherches Nucleaires, Strasbourg). Radiochim. Acta; 13: 217-19(Jun 1970).

The yield of bond ruptures following isomeric transition of ^{133m}Xe in xenon trioxide was measured. The experimental value, 0.85 ± 0.05, corresponds to the internal conversion coefficient of the 232-keV transition in ^{133m}Xe. (auth)

Separation Processes

Refer also to abstracts 50341, 50396, and 51142.

50439 (ANL-7675) CHEMICAL ENGINEERING DIVISION ANNUAL REPORT, 1969. (Argonne National Lab., Ill.). Apr 1970. Contract W-7405-eng-38. 167p. Dep. CFSTI.

The research and development programs of Argonne's Chemical Engineering Division consisted of the following: (1) Pyrochemical processes employing salt-transport separations for the recovery and purification of LMFBR fuel were investigated. Research was also directed to the liquid-metal decladding of LMFBR fuels as an alternative head-end step for aqueous processing. (2) The work on fluid-bed fluoride volatility processing culminated in a conceptual design and evaluation study, which indicated that fluoride volatility methods are technically feasible for the purification and recovery of LMFBR fuels. (3) Work in sodium technology included the study of mechanisms of carbon transport in sodium-steel systems, the establishment of a center for sodium analytical chemistry, and work on the development, evaluation, and improvement of purification devices and on-line monitors for impurities in sodium. (4) Work on the thermodynamics and physical properties of candidate FBR fuels at high temperatures was continued. (5) Calorimetric studies were made of substances of interest in nuclear technology. (6) Studies were made of the chemical behavior of irradiated FBR fuels. This program was directed mainly toward uranium-plutonium oxide fuels, with emphasis on fuel-cladding interactions and fission product migration and interaction. (7) A method for detection of fuel failure in EBR-II was developed in cooperation with the EBR-II project. This method depends on the use of mixtures of xenon isotopes as tags for the identification of a failed fuel element. (8) Studies of the chemistry and thermodynamics of liquid metals, alloys, and molten salts were continued. The work included studies of the thermodynamic behavior of various systems as expressed by liquid-solid phase diagrams, liquid-phase activity coefficients, vapor-liquid equilibria, and solubilities of various gases and solids in liquids. (9) Studies of electrochemical energy conversion by means of cells with liquid metal electrodes and fused-salt electrolytes led to the development of cells which promise many uses as energy storage devices. (10) Studies were continued on the development of methods for determining the burnup of FBR fuels. (11) Measurements of nuclear cross sections of FBR fuel, cladding, and structural materials were continued. (12) Work was carried out on the preparation of ceramic FBR fuel materials. (13) Studies were made to provide physical-property data for use in evaluating the safety of various prospective FBR materials. (14) Fluidized-bed combustion of coal was studied as a means of reducing the emission of pollutants into the air. (auth)

50440 (ARH-SA-69) HANFORD PUREX PLANT EXPERIENCE WITH REDUCTANTS. Walser, R. L. (Atlantic Richfield Hanford Co., Richland, Wash.). 17 Jul 1970. Contract AT(45-1)-2130. 25p. (CONF-701103-4). Dep. NTIS.

From 63rd National Meeting of the American Institute of Chemical Engineers, Chicago, Ill.

Experience with ferrous sulfamate-sulfamic acid (standard), ferrous sulfamate-hydrazine, ferrous nitrate-hydrazine, uranium(IV)-hydrazine, and hydroxylamine nitrate-hydrazine reductant systems in the Hanford Purex Plant is described. Alternate reductant systems are being considered for routine use to reduce the iron and sulfate content of the high level waste. (auth)

50441 (ARH-SA-73) SOLVENT IMPROVEMENT RESULTING FROM THE USE OF NPH IN THE HANFORD PUREX PLANT. Beary, M. M. (Atlantic Richfield Hanford Co., Richland, Wash.). 12 Jun 1970. Contract AT(45-1)-2130. 9p. (CONF-701103-5). Dep. NTIS.

From 63rd National Meeting of the American Institute of Chemical Engineers, Chicago, Ill.

The use of NPH (normal paraffin hydrocarbon mixture) diluent in the Purex Plant provided a significant improvement in plant operation. Solvent quality, plant performance as measured by the Ru-Rh decontamination factors, and the 1C column operations all showed marked improvement during NPH operations. The ruthenium-rhodium arithmetic decontamination factor increased by a factor of 13 to 15 for the uranium solvent extraction system and by a factor of 7 to 14 for the plutonium solvent extraction system. (M.C.G.)

50442 (BARC-497) SEPARATION AND RECOVERY OF LONG LIVED FISSION PRODUCTS ON INORGANIC ION EXCHANGERS. I. SEPARATION OF CESIUM ON COPPER FERROCYANIDE. Ramaswamy, M.; Rajan, N. S. Sunder (Bhabha Atomic Research Centre, Bombay (India)). 1970. 23p. Dep. CFSTI (U. S. Sales Only).

Some experiments designed to increase the exchange capacity of copper and cobalt ferrocyanides for Cs^+ ions were carried out. The effect of refluxing wet precipitates of the above ferrocyanides (prepared by mixing alkali metal ferrocyanide with excess of metal salt solution) with saturated NaCl/KCl/NH_4Cl solutions at both ambient and higher temperatures (100°C) was studied. In the case of copper ferrocyanide, there was a continuous increase in the exchange capacity with increasing time of refluxing and concentration of K^+/NH_4^+ in the mixture, but samples refluxed with saturated NaCl showed a decrease in capacity. In the case of cobalt ferrocyanide, there was also a decrease in the capacity as a result of refluxing at both temperatures with saturated KCl solution. Column experiments with simulated Purex waste ($H^+ = 0.5$ M) showed that the sample of copper ferrocyanide refluxed with saturated NH_4Cl at 100°C had a higher capacity for Cs^+ ions than that refluxed with saturated KCl. The adsorbed Cs^+ could be easily eluted with 5 M NH_4NO_3 at room temperature. (auth)

50443 (BNWL-1391) WASTE SOLIDIFICATION PROGRAM. VOLUME 6. SPRAY SOLIDIFICATION PERFORMANCE DURING FIRST RADIOACTIVE TESTS IN WASTE SOLIDIFICATION ENGINEERING PROTOTYPES. Bond, W. R.; Hartley, J. N.; Mendel, J. E.; McElroy, J. L.; Schneider, K. J.; Schwab, M. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug 1970. Contract AT(45-1)-1830. 202p. Dep. CFSTI.

Solidification of high-level radioactive waste by the Spray Solidification Process was successfully demonstrated. Approximately 7.8 million Ci of radionuclides were processed and collected in 8- and 12-in.-dia containers during six engineering-scale demonstration runs in Waste Solidification Engineering Prototypes (WSEP) at the Pacific Northwest Laboratory. Radioactivity processed was increased from 83,000 Ci in the first run to 3,000,000 Ci in the sixth run. The self-generating heat rate within each receiver pot full of solidified waste was increased from 0.3 to 11 kW (168 W/liter of solid), respectively. The solidified waste within a full 8-in.-dia pot represented 1.8 tonnes of power reactor fuel (irradiated at 20,000 MWd/tonne at a power level of 15 MW/tonne) for sulfate-free PW-1 waste and 0.95 tonnes for sulfate-containing PW-2 waste. High-level aqueous

radioactive waste was processed at overall rates of 11 to 18 liters/hr. The equivalent processing rates ranged from 0.46 to 0.9 tonnes/day of original fuel. From 11 to 75% of the total ruthenium fed to the solidifier was volatilized from the solidifier; entrainment of nonvolatiles was generally less than 0.1%. The WSEP auxiliary equipment consisting of an evaporator, an acid fractionator, filters, and a caustic scrubber reduced radionuclides in the stack gas to well below 10CFR20 release limits. The radionuclide content in the final liquid effluent was decontaminated by a factor of 10^7 for nonvolatiles and 10^4 to 10^5 for radioruthenium to concentrations acceptable for recycle to a fuel reprocessing plant or low-level treatment processes. The spray solidifier product caused no significant pressure increases within the containers after they were capped and welded. (auth)

50444 (CONF-690916-(Vol.2), pp 102-8) SEPARATION OF ^{137}Cs FROM FISSION PRODUCT SOLUTION USING PHOSPHO TUNGSTIC ACID. Murthy, T. S.; Balasubramanian, K. R.; Ananthakrishnan, M. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

Studies were made on the separation of ^{137}Cs from fission product solutions using phosphotungstic acid and the subsequent separation on alumina. The results showed that Cs can be effectively and almost quantitatively precipitated as cesium phosphotungstate from 2 M HNO_3 solutions using 61.6 mg of phosphotungstic acid for every milligram of Cs. Experiments using ^{187}W and ^{32}P as tracers confirmed almost quantitative uptake of phosphate and tungstate ions in the presence of each other on a column of alumina conditioned with HCl at pH 4. After the precipitation and purification on alumina, the γ spectrum of the product Cs showed only the presence of the 0.66-MeV peak due to ^{137}Cs. (P.C.H.)

50445 (CONF-690916-(Vol.2), pp 109-11) SEPARATION OF ^{131}I FROM NEUTRON IRRADIATED TELLURIUM USING HYDROGEN PEROXIDE. Murthy, T. S.; Nair, V. C.; Naik, S. G. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

A method for the separation of ^{131}I from neutron-irradiated tellurium with a yield of about 90% and purity that satisfies the requirements for medical use is described. Hydrogen peroxide is used as an oxidising agent in this method. (auth)

50446 (CONF-690916 (Vol.2), pp 169-73) SEPARATION OF $BiPO_4$ CARRIED ACTINIDES BY BiOCl PRECIPITATION. Iyer, R. S.; Kamath, P. R. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

Separation methods developed for the sequential determination of U, Pu, Th, and Am in the urine of workers engaged in Pu separation plants are described. The alpha emitters are collected on calcium phosphate and U is separated from it with a $BiPO_4$ precipitation. $BiPO_4$ is dissolved in HNO_3 and the tetravalent actinides are held on the anion column. Am and carrier Bi in the effluent are separated by a rapid novel technique of precipitating Bi as oxychloride. Trace actinides carried on the $BiPO_4$ precipitate are separated by hydrolysis of Bi as BiOCl. The final step involves α counting. (auth)

50447 (CONF-690916-(Vol.2), pp 239-43) INVESTIGATIONS ON THE PROCESS CHEMISTRY OF NEPTUNIUM. Srinivasan, N.; Ramaniah, M. V.; Patil, S. K.; Ramakrishna, V. V.; Swarup, Rajendra; Chadha, Ashok (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

Neptunium-237 formed in small but significant amounts during the irradiation of uranium fuel in nuclear reactors can be recovered as a by-product during the reprocessing of the fuel by the Purex process. Analysis of the Purex process solutions at various stages of the process in the plant at Trombay revealed that in the codecontamination cycle, neptunium is extracted, along with plutonium and uranium, into TBP almost quantitatively while in the partitioning cycle the extraction is reduced to about 50%. In the uranium purification cycle, most of the neptunium follows uranium into TBP. Less than 20% of neptunium accompanies the plutonium stream during partitioning. The effects of nitric acid concentration and TBP saturation with uranium on the extraction of neptunium (IV) and neptunium (VI) into 30% TBP in Shell-sol-T have been studied and the details are reported. (auth)

50448 (CONF-690916-(Vol.2), pp 283-9) LABORATORY INVESTIGATIONS IN NON-AQUEOUS PROCESS CHEMISTRY. Hariharan, A. V.; Sood, D. D.; Sood, S. P.; Prasad, Rajendra; Sampathkumar, R. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

A chloride volatility scheme for reprocessing ThO_2-UO_2 and UO_2-PuO_2 fuels has been developed. In this scheme the oxides are converted to chlorides by reaction with chlorine gas saturated with carbon tetrachloride at high temperature. Separation is based on the high volatility of UCl_5 and UCl_4 compared to other chlorides. Separation of uranium from fission product chlorides having high volatility, e.g., $ZrCl_4$, $MoCl_5$ and $NbCl_5$, is achieved by use of a heated sodium chloride bed. Chlorination of ThO_2 and UO_2 in molten salt media is also reported. A molten salt-liquid metal extraction process using $MgCl_2-MgF_2$ salt phase and Zn-Mg alloy as the metal phase at 800°C is reported for the reduction of UO_2 and ThO_2. (auth)

50449 (DOCKET-50201-46) WEST VALLEY REPROCESSING PLANT. Head End Ventilation System. Final Safety Analysis Report, Suppl. 4. (Nuclear Fuel Services, Inc., West Valley, N. Y.). 8 Oct 1970. 14p. Dep. CFSTI.

The effect of a tornado on the head-end ventilation system was re-evaluated. The effect of blow-backs due to partial failure of system components was investigated. The exhaust filter differential pressure and ventilation are discussed. (M.C.G.)

50450 (DOCKET-50201-47) WEST VALLEY REPROCESSING PLANT. Approval of Proposed Change No. 13 to Technical Specifications. (Division of Materials [and] Licensing (AEC), Washington, D. C.). 16 Oct 1970. 21p. Dep. NTIS.

Operation of the head-end ventilation system is reviewed. The exhaust filter differential pressure, ventilation, emergency utility equipment, air filtration equipment, and safety analysis of head-end ventilation and master-slave manipulator repair and decontamination shop are discussed. (M.C.G.)

50451 (DOCKET-50332-17) BARNWELL NUCLEAR FUEL PLANT. Safety Evaluation: Addendum and Errata Sheet. (Division of Reactor Licensing (AEC), Washington, D. C.). 9 Oct 1970. 2p. Dep. CFSTI.

Seven revisions in wording of the safety evaluation are given. These revisions did not affect the conclusions of the AEC regulatory staff. (M.C.G.)

50452 EXTRACTION CHROMATOGRAPHIC COLUMN METHOD FOR RAPID AND CONTINUOUS SEPARATION OF SHORT-LIVED RADIONUCLIDES AS PHTHALOCYANINE COMPLEXES. Pfrepper, G.; Herrmann, E.; Christow, D. (Joint Inst. for Nuclear Research, Dubna, USSR). Radiochim. Acta; 13: 196-200(Jun 1970). (In German).

A microsynthesis for the rapid transfer of radioactive rare earth fractions of the type obtained, e.g., in the chromatographic separation of spallation products, in phthalocyanine complexes, and an extraction chromatography column method for the fast mother-daughter separation are described. The fraction of interest is heated to 298°C for 5 min in the presence of 0.5 mg of carrier with 50 mg of o-phthalodinitrile. The yield for the synthesis for rare earths with an atomic number >62 was 70 to 100%. The reaction product was soluble in 0.25 ml of quinoline and could be fixed on silica gel and teflon. The columns obtained allow the quick separation of shortlived daughter products with a half-life ≤1 min and their continuous measurement. In the radiochemistry of the rare earths, the column method has gained special significance in the rapid mother-daughter separation. (auth)

50453 IMPROVEMENTS IN OR RELATING TO THE PROCESSING OF IRRADIATED NUCLEAR FUEL. Mills, Alfred Leonard; Hartley, Kenneth (to United Kingdom Atomic Energy Authority). British Patent 1,205,169. 16 Sep 1970. Filed 18 Sep 1968.

Reference is made to the reprocessing of irradiated monocarbide fuel containing U and Pu. The conventional process involves solvent extraction from HNO_3 solution, and a difficulty that arises is that complex organic compounds are produced by the action of HNO_3 on the fuel. Such compounds cause difficulties in solvent extraction processes because they interfere with solvent/aqueous phase disengagement and complicate the Pu processing. They can also be a hazard in the raffinates by being a source of "fume-off" reactions or even explosions in fuel storage tanks in the event of cooling failure. In the process described the irradiated monocarbide is converted to oxide by heating in CO_2. The oxidation product is soluble in HNO_3 and the solution can be treated by conventional solvent extraction methods for recovery of U and Pu. The disadvantages of other methods of oxidation are mentioned. Oxidation is preferably carried out at 1000 to 1100°C. The method

may be applied to mixed monocarbides and single phase solid solutions, and up to 30% sesquicarbide may be present. (UK)

50454 ELECTROCHROMATOGRAPHY IN THE SEPARATION OF IONS. Majumdar, A. K.; Mitra, B. K. (Jadavpur Univ., Calcutta). Mikrochim. Acta; No. 3, 596-9(1970).

An electrochromatographic technique has been used for the separation of metal ions in the 10 to 15 μg range within 3 hours and at 150 V from a large number of mixtures. While azide and hydroxylamine gave separations from 4-component mixtures, thiocyanate, thiosulfate, and hydrazine were more suited for ternary separations. (auth)

50455 CRITERIA AND POSSIBILITIES OF UNI-STAGE RADIOCHEMICAL SEPARATION METHODS IN ROUTINE ANALYSIS. Zaduban, Milan (Safarik-Univ., Kosice, Czech.). Mikrochim. Acta; No. 3, 433-42(1970). (In German).

The factors that influence the establishment of criteria for uni-stage enrichment- and separation procedures (especially for routine analysis) are discussed. Among the more important criteria are: specificity, chemical yield, enrichment factor, speed, technically simple separation conditions, measuring form of the sample and the measuring effectiveness. The criteria are chosen in such a manner that the chemical and the radiometric portion of the procedure are connected. Among the more important chemical factors is the volume concentration factor and the factor of the chemical yield, which together constitute the enrichment- and separation factor. The choice of the most favorable methods of radiochemical analysis can be made for the case at hand with the aid of the determination factor. The best correspondence to the stated criteria is found in the determination methods whose isotope exchange and specific ion exchange are based on specific focusing sorption or extraction. (auth)

50456 SEPARATION OF URANIUM ISOTOPES BY CHEMICAL EXCHANGE. Shimokawa, J.; Kobayashi, F. (Japan Atomic Energy Research Inst., Ibaraki). Isotopenpraxis; 6: 170-6 (May-Jun 1970).

The isotope separation effect between U(IV) complex and U(VI) ions was investigated in a mixed system of uranyl solution and cation exchange resin containing uranous ions. The columns were filled with the water slurry of the U(IV)-form resin particles. From the variation of the isotope abundance ratio $^{235}U/^{238}U$ of U(VI) in the effluent, it was found that: the apparent process of the isotope exchange under study is represented as $[U^{(5)}\ (IV)\ complex]_{resin} + [U^{(8)}\ (VI)O_2^{+2}]_{sol.} \underset{K}{\rightleftharpoons} [U^{(8)}\ (IV)\ complex]_{resin} + [U^{(5)}\ (VI)O_2^{+2}]_{sol.}$; the heavy uranium isotopes are concentrated preferentially in the U(IV) complex ions; the equilibrium constant, K, is about 1.0005, independently of the experimental conditions; and the rate of isotope exchange is extremely sensitive to temperature. (auth)

50457 SEPARATION OF NIOBIUM, TUNGSTEN, MOLYBDENUM, AND ZIRCONIUM BY PARTITION CHROMATOGRAPHY. Gibalo, I. M.; Mymrik, N. A. (Moscow State Univ.). Zh. Anal. Khim.; 25: 1744-7(Sep 1970). (In Russian).

A study was made of the extraction of Nb(V), W(VI), Mo(VI), and Zr(IV) under static conditions and their sorption under dynamic conditions with Teflon in the system HCl–0.5M solution of trioctylamine in benzene. An extraction–chromatographic method was developed for separating Nb(V) from W(VI) and Zr(IV), and Nb(V) from Mo(VI) and Zr(IV). (auth)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 50347, 50396, 50480, 50800, and 51777.

50458 (CEA-CONF-1618) VALIDITY AND INTERPRETATION OF ^{14}C AGES. Delibrias, G. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1970. 18p. (In French). (CONF-701008-1). Dep. CFSTI (U. S. Sales Only).

From Meeting on Stratigraphy Methods and Tendencies, Orsay, France.

The chief known causes of error likely to affect ages determined by the carbon-14 method are listed. Special attention is paid to the consequences: first, of variations with time of the $^{14}C/^{12}C$ ratio, which seem to be bound up with changes in the strength of the earth's magnetic field and lead to an underestimation of up to 800 years for ages of 6000 years; and second, of isotopic effects and pollutions which change the initial carbon ratio $^{14}C/^{12}C$ of the samples. The age errors caused by these various contaminations are worked out as a function of their magnitude. In addition, although the value 5,568 years is used for the half-life of ^{14}C, a recent determination gave the average value as 5,730 ± 40 years and this must be taken into account. (auth) (France)

50459 PRECISION OF THE $^{40}Ar/^{39}Ar$ DATING TECHNIQUE. Berger, Glenr W.; York, Derek (Univ. of Toronto). Earth Planet. Sci. Lett.; 9: 39-44(Aug 1970).

With 1 billion yr old biotite as standard, eight replicate analyses on a basaltic whole rock yield a precision of 1.5% (1σ) on a single $^{40}Ar/^{39}Ar$ age and an arithmetic mean age of 1058 Myr, in close agreement with the conventional K–Ar age of 1074 ± 30 Myr. Purified calcium carbonate was irradiated and analyzed to evaluate the significance of calcium-derived argon isotopes. The results indicated that less than 1.5% of the A^{-38} signal and less than 0.5% of the Ar^{-39} signal were generated from ^{40}Ca and ^{42}Ca respectively. Corrections for these interference reactions were calculated from measurements on the calcium-derived ^{37}Ar and used in the age calculations. The results indicate that basaltic rocks over 100 Myr old (say) may be dated with the $^{40}Ar/^{39}Ar$ technique. (auth)

50460 WATER-PRESSURE EFFECT ON FISSION-TRACK ANNEALING IN AN ALPINE MUSCOVITE. Lakatos, Stephen; Miller, Donald S. (Rensselaer Polytechnic Inst., Troy, N. Y.). Earth Planet. Sci. Lett.; 9: 77-81(Aug 1970).

Fission-track annealing experiments carried out on surface tracks in a muscovite under varying conditions of temperature, time and water pressure indicate that the latter is an important variable. A direct relationship between track stability and water pressure has been established in the 0.25 to 2.0 kb range at 350°C and 3 hours annealing time. As a result, interpretations of fission-track ages obtained on mica may need to take into account this variable as one possible cause for abnormally low ages. (auth)

50461 MONSOON CIRCULATION FROM OBSERVATIONS OF NATURAL RADON. Rao, Y. P. (Meteorological Office, Poona, India); Desai, B. N. Earth Planet. Sci. Lett.; 9: 68-70(Aug 1970).

It was shown that interpretations of the radon results of Rama in recent papers are not tenable. It is not easy to interpret and utilize the radon results for identifying air masses over the Arabian Sea as they represent integrated effect of various factors. (auth)

50462 CONSTITUTION OF TERRESTRIAL GAMMA RADIATION. Minato, Susumu; Kawano, Minoru (Nagoya Univ., Japan). J. Geophys. Res.; 75: 5825-30(10 Oct 1970).

Pulse-height distributions due to terrestrial γ radiation were determined by using a 3″φ × 3″ NaI(Tl) scintillation counter. The distributions were unfolded by a response matrix method, and true photon spectra were obtained. Accurate ionization intensities due to the terrestrial γ radiation were calculated from the spectra, and these values were compared favorably with those measured with an ionization chamber. Mean energy of the terrestrial γ radiation was also calculated from one of those spectra. Primary components due to the uranium and thorium series and to potassium-40 were successively subtracted from the true spectrum to obtain the scattered component of the terrestrial γ radiation and the buildup factor in the soil. (auth)

50463 GEOLOGICAL AND MINING UTILIZATION OF RADIOISOTOPES. Adam, Laszlo. Banyasz. Kut. Intez., Kozlem.; 13: 163-77(1969). (In Hungarian).

Cobalt-60, ^{137}Cs, ^{75}Se, ^{90}Sr, and ^{131}I uses in mining, hydrology, and material composition studies are reviewed. (Selenium-Tellurium Abstr.)

50464 DEVELOPMENT OF CERTAIN RADIOMETRIC METHODS APPLIED IN MINING AND GEOLOGY IN POLAND. Gorski, Ludwik; Lenda, Andrzej; Przewlocki, Kazimierz (Inst. of Nuclear Techniques, Krakow). Nukleonika; 14: 1215-39(1969).

The trends in the application of nuclear techniques in mining, geology and nuclear geophysics which have been developed in Poland in the last few years are reviewed. The application of radioisotope techniques in underground mining, in nuclear geophysics and hydrogeology, and in radiometric analytical methods used in solving mining and geological problems is discussed. The first part dealing with the application of the nuclear techniques in mining, gives the results of measurements of the parameters of flow of hydromixtures in pipelines and the results of investigations on deposited back-fill in exploited areas. The geophysical part reviews the work performed on natural gamma logging of boreholes (choice of units, selective gamma logging in uranium prospecting) and density measurements by means of the gamma-gamma method (elimination of the influence of chemical composition, calibration of probes, etc.). In the hydrogeological part a description of original apparatus is given. Finally, radiometric analysis methods of determining Pb, Zn, Cu, Ba, Zr, Fe, NaCl, and H_2O are presented. (auth)

Meteorology

Refer also to abstracts 50645 and 50805.

50465 (CONF-690916-(Vol.2), pp 90-4) STUDIES ON ^{210}Pb ACTIVITY IN INDIA. Joshi, L. U.; Rangarajan, C.; Gopalakrishnan, Sarada (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23–26, 1969. Vol. II.

Lead-210, which is an important constituent of natural radioactivity, was radiochemically separated from air and rainwater samples from a number of stations in India. The variation of ^{210}Pb levels showed that a maximum of activity occurs in the winter. The specific activity of rainwater was found to increase at about 30°N. The surface air activity in Gangtok in winter was found to be higher than at other stations. The causes for these observations are discussed. (auth)

50466 (NP-18337) DIURNAL VARIATION OF THE RADIOACTIVITY IN THE ATMOSPHERE NEAR EARTH. ([Zentralanstalt fuer Meteorologie und Geodynamik, Vienna (Austria)]). 1969. 15p. (In German). Dep. CFSTI (U. S. Sales Only).

The daily values of radioactivity measured 2 m from the ground at Bregenz, Klagenfurt, Salzburg, and Vienna during Oct., Nov., and Dec. 1969 are presented in tabular form. (J.S.R.)

50467 (NP-18413) NEUTRAL ULTRAFINE PARTICLES. Couturaud, Jean-Claude (Toulouse Univ. (France). Faculte des Sciences). 1970. 84p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis.

Theoretical data on the diffusion coefficient of neutral particles in a gas are given. A new method for the analysis of a polydispersed aerosol by means of a diffusion battery is described. It is applied to the study of the evolution of the diffusion coefficient for neutral ultrafine particles with a metallic nucleus due to recombination of radioactive ions $^{212}_{82}Pb^{+}$ with negative ions from air. Very stable neutral particles with a diffusion coefficient lying between 4.6 and 5.4×10^{-2} cm^2 sec^{-1} were observed. The experiments were made in a filtered and cycled atmospheric air. The influence of the water vapor and of the organic ones was investigated. The part played by the ultraviolet radiation in the coagulation phenomena was determined. These results were compared to those obtained by various authors who observed an increase of the neutral diffusion coefficient in atmospheric air. (auth) (France)

50468 THE METEOROLOGIC STATION OF THE J.E.N. FOR STUDYING ATMOSPHERIC DIFFUSION. PART I. FUNDAMENTALS OF ATMOSPHERIC DIFFUSION AND THE UTILIZATION OF METEOROLOGIC SENSORS. Alonso, A.; Diez-Moreno, A.; Munoz, I.; Sanchez-Izquierdo, I.; Tapia, J.; Trueba, P.; Warsanskyj, W. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 13: 249-58(May-Jun 1969). (In Spanish).

The importance of radioactive contaminant transport in the

atmosphere in the evaluation of the risks of nuclear installations was analyzed and determined. By an analysis of the causes which determine the atmospheric diffusion, the meteorological variables which must be measured in order to describe accurately the phenomenon of diffusion are deduced. The meteorological station considered adequate for the measurement of these variables is described. Special importance is given to the analog and digital processes made with electrical signals proportional to the values of the variables measured. Such processes are of basic importance as they permit the results to be presented in a form directly applicable to the quantitative study of contaminants in the atmosphere, and therefore, to the resolution of a multitude of practical problems such as the evaluation of the sites for nuclear installations, the analysis of risks of such installations both in normal operation and in the case of accidents, and the prediction of the consequences of an accident. (tr-auth)

Mineralogy and Exploration

50469 FRENCH PRESENCE ON THE URANIUM MARKET. Houdaille, M. Energ. Nucl. (Paris); 12: 311-12(Jul-Aug 1970). (In French).

Following the explorations conducted by the Commissariat à l'Energie Atomique and industry, the French uranium reserves allow France to rank 4th in the Western World. This production capacity will exceed the domestic need and the excess will be sold on the world market through Uranex which can expect an important position on a market where supply will stay above demand for some years. (auth) (France)

50470 URANIUM AND THORIUM IN THE TEMIRSH GRANITE MASSIF AND THEIR SIGNIFICANCE FOR THE AGE CORRELATION OF INTRUSIVE FORMATIONS. Nikolaev, V. F.; Perekalina, T. V. Vop. Magmat. Metamorfiz.; 3: 83-9(1968). (In Russian).

Analyses of U and Th content in the granitoid intrusion, Temirshi, found 100 km southeast of the town of Karakalinsk, showed that regularities in U distribution in the intrusion and in the surrounding areas can be used for geologic studies of the region and for age correlations of intrusive deposits of the region. (R.V.J.)

Oceanography

50471 (ORO-3298) TRACING OF COASTAL SEDIMENTS MOVEMENT AT CAPE CANAVERAL. (Florida Univ., Gainesville. Engineering and Industrial Experiment Station). Aug 1970. Contract AT(40-1)-3298. 60p. Dep. CFSTI.

Solid particle transport by ocean waves and currents was studied to evaluate the environmental hazards associated with the release of fission products from a nuclear rocket flight operation, when such fallout is deposited on an ocean surface. This study was confined solely to bed-load material (sand) tracing in the near shore zone (water depths to 30 ft.). The tracing material used for simulating rocket waste products was a cement-based aggregate which was ground and screened to achieve the particle size distribution calculated for the waste product. Fluorescent organic pigments and dyes were incorporated into the tracer material. The tracer material was injected off-shore near Cape Kennedy at depths of 10, 20, and 30 ft on Nov. 17, 1965 and Feb. 2, 1966. On Feb. 15, 1966 sampling was conducted off-shore and on the beach. No particles from the 20 and 30 ft injections were found. In May 1968 tracer material was released at 10 and 20 ft depths, and beach scanning resumed. Analysis of the tracing data and information about the physical environment of the experiments, i.e., wave characteristics, winds, shore contour, led to the following conclusions: the particles move rapidly onto the beach from depths of 20 ft or less and continually move onto the beach over a long period of time (more than 3 yrs); movement onto the beach increased during times of great on-shore wave power; due to the complex bathymetry of the test area, data from this experiment cannot be extrapolated to other offshore areas; the shape of the particles used to simulate nuclear rocket engine-produced fission products influenced the particle movement with larger particles moving more than smaller particles; the beach level fluctuated ±1 ft and could result in the covering and uncovering of particles on the beach; and more measured data on the physical characteristics of the environment would be required to attempt a correlation of tracer movement with the physical environment. (L.C.L.)

50472 OCEANIC ^{3}He: CONTRIBUTION FROM COSMOGENIC TRITIUM. Craig, Harmon (Univ. of California, San Diego, La Jolla); Clarke, W. B. Earth Planet. Sci. Lett.; 9: 45-8(Aug 1970).

The effects of cosmogenic tritium on the excess ^{3}He in oceans were calculated and compared with measured data. It is concluded that decay of natural ^{3}H supplies only 2 to 7% of the ^{3}He influx, and that there is no evidence of any significant production of ^{3}He from decay of tritium. (L.C.L.)

50473 $^{234}U/^{238}U$ ACTIVITY RATIOS IN SOUTH PACIFIC OCEAN WATERS. Krishnaswamy, S.; Lal, D.; Somayajulu, L. K. (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sect. A; 71: 238-41(May 1970).

Analyses of uranium extracted from south Pacific waters by the in-situ extraction method point to a uniform depth independent value of 1.14 ± 0.02 for the $^{234}U/^{238}U$ activity ratio. This value is also the same, within one standard deviation, as that determined for the north Pacific, south Indian and Atlantic waters. (auth)

Seismology

50474 (NVO-1163-211) ANALYSIS OF THE APPLICABILITY OF EXISTING ANALYTIC MODELS FOR THE DESCRIPTION OF OBSERVED SEISMIC AMPLIFICATION EFFECTS. Murphy, J. R.; Weaver, N. L.; Lamers, G. B. (Environmental Research Corp., Las Vegas, Nev.). Sep 1970. Contract AT(29-2)-1163. 103p. Dep. CFSTI.

This report presents a comprehensive examination of the amplification of ground motion by near-surface station geology from both the analytical and experimental viewpoints. The mathematical models available to describe amplification are presented and their limitations indicated. The geology of a number of Nevada Test Site seismic recording stations is described in detail and the quality of the available physical property data is assessed. A usable experimental amplification factor is defined in such a way that it is meaningful in terms of the available mathematical models. Experimental amplification factors are obtained for a wide variety of station geologies and ground motion intensities. The applicability of the various analytical models is tested using the observed amplification factors. The major conclusion is that the available mathematical models are generally adequate to describe the major features of the observed amplification for the station geologies investigated. (auth)

50475 (ORO-3822-6) RECOMMENDATIONS FOR EXPERIMENTAL VERIFICATION OF SOIL-STRUCTURE INTERACTION ANALYSIS. Report No. 4. Scavuzzo, R. J. (Toledo Univ., Ohio. Research Foundation). Sep 1970. 20p. Dep. NTIS.

Previous theoretical investigation of soil-structure interaction, i.e., how the inertia of large reactor structures interact with the free field seismic ground motion to alter this motion and therefore affect the seismic forces on the structure, have shown that the interaction effects are dependent on ground stiffness and the relationship between the frequency characteristics of the seismic motion and the natural frequencies of the structure. Furthermore, these effects are important enough to be considered in the seismic design of nuclear power plants. A test program for verifying these theoretical results is proposed. It is recommended that low-level force tests on existing nuclear reactor facilities be conducted using ground shakers or small explosive charges. (L.C.L.)

50476 SOURCE-DEPTH DETERMINATIONS USING SPECTRAL, PSEUDO-AUTOCORRELATION AND CEPSTRAL ANALYSIS. Cohen, T. J. Geophys. J. Roy. Astron. Soc.; 20: 223-31(Aug 1970).

Interference between P and pP (or P_a and pP_a) in a seismic signal causes the spectrum of the combined wave train to be scalloped with a period equal to the depth-phase delay time τ. Determination of the null frequency interval ($\Delta f = 1/\tau$), together with a knowledge of the overburden compressional velocity, permits an estimate of the source depth to be made. Scalloping produced by reverberations at the recording station can be reduced by forming the average of a suite of individual station spectra. The spectral bandwidth available for analysis can be broadened by removing instrument response. To determine objectively the periodicities in the average spectrum, the cepstrum and pseudo-autocorrelation are computed. This depth determination method combining spectral, pseudoautocorrelation, and cepstral analysis is applied successfully to Pn or P data sets for three underground explosions whose depths are known a priori. (auth) (UK)

ENGINEERING

Nuclear Explosions

Refer also to abstracts 50474 and 50476.

50477 (NVO–1163-TM-23) PHOTO INTERPRETATION OF CLOSE-IN PHYSICAL EFFECTS OF AN UNDERGROUND NUCLEAR DETONATION. Perchalski, Frank R. (Environmental Research Corp., Las Vegas, Nev.). Sep 1970. 14p. Dep. CFSTI.

Aerial photography provides a quick, economical and accurate technique for determining the surface changes caused by an underground nuclear detonation. Pre-shot and post-shot aerial photography was obtained for the Rulison detonation. These photographs were viewed stereoscopically in order to assess the surface changes associated with the Rulison detonation. The photo interpretation verified that no massive land slides or rock slides occurred as a result of the Rulison event. However, the interpretation revealed that 13 relatively small rock and soil movements occurred within 7 kilometers of Ground Zero. This study did not provide any information concerning physical effects beyond 7 kilometers. (auth)

50478 (STI/PUB–273) PEACEFUL NUCLEAR EXPLOSIONS. PHENOMENOLOGY AND STATUS REPORT, 1970. Panel Proceedings Series. Proceedings of a Panel on the Peaceful Uses of Nuclear Explosions Held in Vienna, 2–6 March 1970. (International Atomic Energy Agency, Vienna (Austria)). Aug 1970. 464p. (In several languages). (CONF-700305). IAEA $12.00.

Eighteen papers were presented at the conference. Separate abstracts were prepared for 10. Eight were previously abstracted in NSA. For abstracts of these see CONF-700305 in the Report Number Index. (L.C.L.)

For abstracts of individual papers see: 50482–50491.

50479 (UCRL–50844) MASS CONCENTRATIONS AND PARTICLE SIZE DISTRIBUTIONS AS A FUNCTION OF TIME WITHIN A NUCLEAR CRATERING CLOUD. Final Report. Gudiksen, Paul H. (California Univ., Livermore. Lawrence Radiation Lab.). May 1970. 20p. Dep. NTIS.

A detailed study was made of how the size distributions and mass concentrations of particles contained within a large atmospheric dust cloud generated by a nuclear cratering experiment vary with time during the first 4 hr after formation. Numerous samples were collected within such a cloud produced by Project Schooner. The samples were collected between 12 min and 4 hr after cloud formation by filters on aircraft penetrating the cloud and by parachute-retarded samplers dropped through the cloud. These samples were analyzed for particle size distributions and mass concentrations, and a mathematical model was developed to account for the observed rate of change of these parameters during the period of interest. The model, for which the measured 12-min mass concentrations and particle size distributions are input data, incorporates the effects of atmospheric diffusion in three dimensions, of gravitational settling of particles within discrete size groups, of distortion of the cloud due to the vertical profile of the horizontal winds, and of the deposition of the particles on the earth's surface. Calculated magnitudes and geographical locations of maxima shown in the mass concentration profiles of the cloud are similar to the magnitudes and locations determined from the analyses of the samples collected by the parachute-retarded samplers during the first 70 min after cloud formation. Likewise, the calculation indicates that the particle size distributions of vertically integrated samples did not change significantly during the first 70 min; this was verified in the analyses. The calculation results agree within a factor of 2 with measurements of mass concentrations shown by samples collected by aircraft within the upper levels of cloud at times between 1 and 4 hr after cloud formation. The calculation results agree within a factor of 2 to 5 with analyses of samples collected by aircraft within the lower portions of the cloud at times between 1 and 4 hr after cloud formation. The mass burden of the 70-min cloud, according to the calculation, had decreased by 22% from its 12-min value, because of deposition. By 4 hr, 52% of the 12-min mass burden had been depleted by deposition. (auth)

50480 (UCRL–50893) MICROFRACTURING IN POSTSHOT GASBUGGY CORE GB-3. Borg, I. Y. (California Univ., Livermore. Lawrence Radiation Lab.). 22 Jun 1970. 16p. (PNE-G-67). Dep. CFSTI.

Microfracturing in the shocked rock of the Ojo Alamo, Picture Cliffs, and Lewis formations has been examined microscopically in core samples. The amount of fracturing observed is small and shows little correlation with distance from the shot point, but it does show qualitative correlation with permeability measurements on the same cores. Fractures are short-lived in the sandstones and terminate within individual grains or die out in the semiductile cementing clays and micas. The finer-grained sediments show extensive dilation on bedding and other compositional boundaries that results in open breaks ranging in width from less than 1 μ to greater than 50 μ. At overburden pressure, it is questionable whether bedding dilations in fine, grained shales would appreciably increase the permeability over time intervals measured in years. Calculated peak radial, tangential, and mean stresses for the core samples indicate that the maximum stresses seen by the rocks are in the 6 to 8 kb range and are somewhat below the yield strengths of the rocks as measured in laboratory triaxial tests. Exact behavior of any rock below its ultimate strength is largely unknown, but it probably includes incipient fracture and ductility (slip or cataclastic flow) in the case of the transitional-type failure expected for Gasbuggy rocks. Comparisons of shock effects in brittle granodiorite and in the semibrittle Gasbuggy rocks at the same peak radial stresses indicate that matrix fracturing in the granodiorite is many times greater than that observed in Gasbuggy rocks. It points up the important role that weak cementing minerals in the Gasbuggy rocks have had in determining the mode of yielding of the whole. (auth)

50481 (UCRL–50897) CALCULATIONS OF FLUID STEMMING BEHAVIOR FOR CRATERING EXPERIMENTS. Stubbs, T. F.; Crowley, B. K. (California Univ., Livermore. Lawrence Radiation Lab.). 25 Jun 1970. 13p. Dep. NTIS.

The feasibility of using a liquid for stemming the emplacement hole in a cratering experiment was briefly investigated. A preliminary analysis is first discussed in which an analytic solution is found for a rigid cylindrical stemming plug. The effects of variations in density and friction of the plug are examined. A more realistic analysis of fluid stemming, based on numerical calculations, is then discussed. This brief investigation is in no way conclusive; however, it does suggest that some of the denser liquid stemming materials could be feasible. The need for realistic experiments and their calculational comparisons is also indicated. (auth)

50482 STATEMENTS ON NATIONAL PROGRAMS. pp 1–45 of Peaceful Nuclear Explosions. Phenomenology and Status Report, 1970. Vienna; International Atomic Energy Agency (1970). (In several languages).

From Meeting on Technical Aspects of Peaceful Uses of Nuclear Explosives, Vienna, Austria. See STI/PUB–273; CONF-700305.

Summaries are presented of the national research and development programs on peaceful uses of nuclear explosives being conducted by the following countries: Australia, France, India, Japan, South Africa, Sweden, UK, US, and USSR. (L.C.L.)

50483 EFFECTS OF AN UNDERGROUND NUCLEAR EXPLOSION ON THE ROCK MEDIUM. STUDY OF THE CONTENTS OF THE CAVITY AND CHIMNEY, AND STUDY OF THE CRUSHED AND FRACTURED ZONES. Derlich, S. (CEA, Paris). pp 123–38 of Peaceful Nuclear Explosions. Phenomenology and Status Report, 1970. Vienna; International Atomic Energy Agency (1970). (In French).

From Meeting on Technical Aspects of Peaceful Uses of Nuclear Explosives, Vienna, Austria. See STI/PUB–273; CONF-700305.

French nuclear experiments in a granite massif have created cavities and associated chimneys due to rock collapse. The cavities are surrounded by concentric zones of crushed and fractured rock. Transformations in the rock medium have been studied by means of boreholes which pass near the detonation point or are drilled to various parts of the cavity or chimney. The lower half of the cavity is roughly hemispherical. The geometry of the chimney is affected by the geological nature of the rock medium and by the extent to which it is already fractured. The shape of the cavity-chimney complex resembles an ellipsoid of revolution whose major axis is 4.5 times and minor axis 2.8 times the cavity radius. The contents consist of debris and resolidified molten rock. The crushed zone consists of coherent rock of chalk-like appearance with porosity of 14% and permeability of the order of 10 millidarcy. The fractured zone consists of fragmented rock of increasing size as one moves away from the detonation point. The relationship between the energy of the explosion W (in kilotons) and the cavity radius R (in meters) is in good agreement with the theoretical laws based on physical phenomena. The relation does not always cor-

respond to the formulas proposed elsewhere for other rock media, or even for granite. The differences can be explained in terms of parameters such as the pressure of vaporized products, constants derived from the equations of state, the dimensions of the explosive canister and the stresses in the rock. (auth)

50484 MECHANICAL EFFECTS IN THE CLOSE ZONE OF A SUBTERRANEAN NUCLEAR EXPLOSION IN GRANITE. Michaud, L.; Maury, J. (CEA, Paris). pp 139-50 of Peaceful Nuclear Explosions. Phenomenology and Status Report, 1970. Vienna; International Atomic Energy Agency (1970). (In French).

From Meeting on Technical Aspects of Peaceful Uses of Nuclear Explosives, Vienna, Austria. See STI/PUB-273; CONF-700305.

During the French subterranean nuclear experiments at Hoggar a large number of measurements and observations were made in the close zone, to determine in particular the time of arrival of the shock wave and the characteristics of the cavity formed by the explosion. Codes of calculation were developed in order to predict and interpret the various results. The S-code, in particular, is a Lagrangian unidimensional code giving a numerical simulation of the propagation of the shock wave. In addition to calculation of the shock parameters, it provides a means of evaluating the following effects: vaporization and liquefaction due to shock; crushing and brittle or plastic rupture of the material; opening and closing of radial and tangential fractures; elastoplastic and elastic deformations of a solid; the initial profile of the energy liberated by the shock in the form of heat. Applied to the case of granite, the S-code, supplemented by the adiabatic elasticity and the characteristic quantities of the medium as determined in the laboratory, enabled us to describe all the characteristic phenomena in the close zone. Calculated and experimental results for the time of arrival of the shock wave are compared and good agreement is obtained up to pressures of several megabars. Detectors located up to a few decimeters from the wall enabled us to follow the evolution of the shock wave during the first few microseconds of its travel. Calculations also show that the dimensions of the final cavity are a function not only of the explosion energy and local lithostatic pressure but also of the shear strength of the rock and the dimensions of the firing chamber. (auth)

50485 MECHANICAL EFFECTS BEYOND THE CLOSE ZONE OF A SUBTERRANEAN NUCLEAR EXPLOSION IN GRANITE. Michaud, L. (CEA, Paris). pp 151-61 of Peaceful Nuclear Explosions. Phenomenology and Status Report, 1970. Vienna; International Atomic Energy Agency (1970). (In French).

From Meeting on Technical Aspects of Peaceful Uses of Nuclear Explosives, Vienna, Austria. See STI/PUB-273; CONF-700305.

During French nuclear experiments in a granite massif at Hoggar, the movements of the medium were recorded by mechanical detectors measuring displacements, velocities and accelerations. The results are fairly well grouped and the principles established experimentally for the widely differing explosion energies and distances from ground zero agree well with similarity ratios having the following form: movement = $K(W^{\frac{1}{3}}/R)^n$, with a dispersion not exceeding 50%. In addition, a number of observations were made on structures and materials exposed to such movements. Several hundred photographs were taken before and after the explosions in horizontal galleries oriented towards ground zero and also on the surface of the massif. The results make it possible to calculate limiting distances for damage for each type of material and mode of attachment. For example, with a particular type of light concrete block construction, the limiting distance for medium damage (very obvious cracks) is found to be 700 $m/kt^{\frac{1}{3}}$. A study correlating ground movements and the extent of the damage shows the material velocity of ground movement at the point of interest to be the most reliable criterion of the observed effect. For the above example, the radial displacement velocity is 18 cm/s. Further data have been collected on different sorts of material, metal containers, electronic equipment, electric motors, etc. The results enable us to predict the probable damage from a nuclear explosion and to make recommendations to minimize such damage. (auth)

50486 GASES FORMED DURING AN UNDERGROUND NUCLEAR EXPLOSION: CHEMICAL EQUILIBRIA AND POTENTIAL APPLICATIONS. Cohen, P. (CEA, Paris). pp 199-209 of Peaceful Nuclear Explosions. Phenomenology and Status Report, 1970. Vienna; International Atomic Energy Agency (1970). (In French).

From Meeting on Technical Aspects of Peaceful Uses of Nuclear Explosives, Vienna, Austria. See STI/PUB-273; CONF-700305.

The results obtained on the composition and quantities of gas produced during underground explosions in Sahara granite are restated and interpreted. The problems involved in such evaluation in the case of an oil shale medium are emphasized. Several possible applications in the petrochemical industry (fertilizers, etc.) for hydrocarbons originating from nuclear stimulation are proposed and discussed. (auth)

50487 RADIOACTIVITY AND ITS FRACTIONATION DURING UNDERGROUND SHOTS IN A GRANITE MEDIUM. Cohen, P. (CEA, Paris). pp 211-29 of Peaceful Nuclear Explosions. Phenomenology and Status Report, 1970. Vienna; International Atomic Energy Agency (1970). (In French).

From Meeting on Technical Aspects of Peaceful Uses of Nuclear Explosives, Vienna, Austria. See STI/PUB-273; CONF-700305.

Results are presented on samples obtained from underground shots in the Sahara. Sampling methods for gases and solids are described. The evolution of the radioactive composition of the gases as a function of sampling times and sites is discussed (tritium, ^{37}Ar, fission gas). Certain activation products have been determined (tritium, ^{41}Ca, ^{37}Ar). The homogeneity of fission products and fissionable materials in vitrified samples has been confirmed in granite, the vitrified mass of which is 1300 t/kt. (auth)

50488 NUMERICAL SIMULATION OF STRESS-WAVE PROPAGATION FROM UNDERGROUND NUCLEAR EXPLOSIONS. Cherry, J. T.; Petersen, F. L. (Univ. of California, Livermore). pp 241-325 of Peaceful Nuclear Explosions. Phenomenology and Status Report, 1970. Vienna; International Atomic Energy Agency (1970).

From Meeting on Technical Aspects of Peaceful Uses of Nuclear Explosives, Vienna, Austria. See STI/PUB-273; CONF-700305.

A numerical model of stress wave propagation (SOC) is presented which uses material properties data from a preshot testing program to predict the stress-induced effects on the rock mass involved in a Plowshare application. SOC calculates stress and particle velocity history, cavity radius, extent of brittle failure, and the rock's efficiency for transmitting stress. The calculations are based on an equation of state for the rock, which is developed from preshot field and laboratory measurements of the rock properties. The field measurements, made by hole logging, determine in situ values of the rock's density, water content, and propagation velocity for elastic waves. These logs also are useful in judging the layering of the rock and in choosing which core samples to test in the laboratory. The laboratory analysis of rock cores includes determination of hydrostatic compressibility to 40 kb, triaxial strength data, tensile strength, Hugoniot elastic limit, and, for the rock near the point of detonation, high-pressure Hugoniot data. Equation-of-state data are presented for rock from three sites subjected to high explosive or underground nuclear shots, including the Hardhat and Gasbuggy sites. SOC calculations of the effects of these two shots on the surrounding rock are compared with the observed effects. In both cases SOC predicts the size of the cavity quite closely. Results of the Gasbuggy calculations indicate that useful predictions of cavity size and chimney height can be made when an adequate preshot testing program is run to determine the rock's equation of state. Seismic coupling is very sensitive to the low-pressure part of the equation of state, and its successful prediction depends on agreement between the logging data and the static compressibility data. In general, it appears that enough progress has been made in calculating stress wave propagation to begin looking at derived numbers, such as number of cracks per zone, for some insight into the effects on permeability. A listing of the SOC code is appended. (auth)

50489 THEORETICAL MODEL OF THE EARLY PHASES OF AN UNDERGROUND EXPLOSION. Cameron, I. G.; Scorgie, G. C. (Atomic Weapons Research Establishment, Aldermaston, Eng.). pp 331-43 of Peaceful Nuclear Explosions. Phenomenology and Status Report, 1970. Vienna; International Atomic Energy Agency (1970).

From Meeting on Technical Aspects of Peaceful Uses of Nuclear Explosives, Vienna, Austria. See STI/PUB-273; CONF-700305.

Calculations that can be made to understand the early dynamics of an intense underground explosion are outlined. For a contained shot this period covers the growth of the cavity to substantially maximum size and the crushing, fracture and plastic deformation of the rock. For a cratering shot the period covers the growth of the cavity and the early stages of the rising mound formed on the surface of the ground. Applications are made to a high explosive cratering shot and to a nuclear explosive contained shot. For the latter an indication is obtained of the sensitivity of the cavity radius to the assumed mechanical properties of the rock. (auth)

50490 RESULTS OF CRATERING EXPERIMENTS. Toman, J. (Univ. of California, Livermore). pp 345-75 of Peaceful

Nuclear Explosions. Phenomenology and Status Report, 1970. Vienna; International Atomic Energy Agency (1970).

From Meeting on Technical Aspects of Peaceful Uses of Nuclear Explosives, Vienna, Austria. See STI/PUB-273; CONF-700305.

Nuclear excavation as a construction technique for producing harbours, canals, highway cuts, and other large excavations requires a high assurance that the yields and depths-of-burst selected for the explosive will produce the desired configuration within an acceptable degree of tolerance. Experimental results from the United States nuclear cratering detonations to date and selected chemical explosives detonations are summarized. A comparison of the cratering curves developed for three categories of materials (dry rock, alluvium, and shale) indicates that differences in physical properties affect crater dimensions more significantly than possible differences in yield scaling exponents. The development of cratering code calculations has made it possible to predict the behavior of explosions in geologically complex formations or in rock formations for which no experience exists. This capability was demonstrated in Project Buggy, a row crater experiment with five 1.1 kt explosives. (auth)

50491 NUCLEAR CRATERING FROM A DIGITAL COMPUTER. Terhune, R. W.; Stubbs, T. F.; Cherry, J. T. (Univ. of California, Livermore). pp 415–40 of Peaceful Nuclear Explosions. Phenomenology and Status Report, 1970. Vienna; International Atomic Energy Agency (1970).

From Meeting on Technical Aspects of Peaceful Uses of Nuclear Explosives, Vienna, Austria. See STI/PUB-273; CONF-700305.

Computer programs based on the artificial viscosity method are applied to developing an understanding of the physics of cratering, with emphasis on cratering by nuclear explosives. Two established codes, SOC (spherical symmetry) and TENSOR (cylindrical symmetry), are used to illustrate the effects of variations in the material properties of various media on the cratering processes, namely shock, spall, and gas acceleration. Water content is found to be the most important material property, followed by strength, porosity, and compressibility. Crater profile calculations are presented for Pre-Gondola Charley (20 ton nitromethane detonation in shale) and Sedan (100 kt nuclear detonation in alluvium). Calculations also are presented for three 1 Mt yields in saturated Divide basalt and 1 Mt yield in dry Buckboard basalt, to show crater geometry as a function of the burial depth for large explosive yields. The calculations show, for megaton-level yields, that gas acceleration is the dominant mechanism in determining crater size and depends in turn on the water content in the medium. (auth)

Facilities and Equipment

Refer also to abstracts 50477, 50510, 50529, 51243, 51574, 51575, 52751, and 52954.

50492 (ARH-SA-68) CONDENSATE RECYCLE: A METHOD OF REDUCING RADIOACTIVE DISCHARGES TO THE GROUND FROM THE HANFORD PUREX PLANT. Henry, K. H. (Atlantic Richfield Hanford Co., Richland, Wash.). 11 Sep 1970. Contract AT(45-1)-2130. 13p. (CONF-701103-1). Dep. NTIS.

From 63rd National Meeting of the American Institute of Chemical Engineers, Chicago, Ill.

The Hanford Purex Plant experience with the in-canyon recycle of process condensate streams is described. The resulting reductions in radioactivity discharged to the environs and the effects of recycle programs upon the Purex process are discussed. Alternatives for further process condensate recycle applications are also presented. (auth)

50493 (CEA-CONF-1506) IMPROVEMENT OF DEVICES FOR DETECTION OF LEAKS USING HELIUM AS A TRACER. Roubeau, P.; Maillard, P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 6p. (In French). (CONF-691210-2). Dep. CFSTI (U. S. Sales Only).

From International Conference on Vacuum and Cold, Grenoble, France.

An apparatus is described for the detection of leaks using helium as tracer. The apparatus consists essentially of a cartridge of activated vegetable carbon, several grams in weight, cooled to the temperature of liquid helium, through which all gases pass in going to the leak detector. By adsorption at 77°K, the activated carbon stops all the gases but helium completely and without appreciable delay. The operational principles of the device are outlined and the results obtained with it show its use improves the detection of leaks. (J.S.R.)

50494 (CEA-N-1251) ELECTROLYTIC MACHINING PROCESS, APPLICATIONS, AND SPECIAL STUDY ON THE TREPANNING OF TEST SPECIMENS IN BUGEY TYPE FUEL ELEMENTS. Bret, Antoine Henri (Commissatiat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Feb 1970. 90p. (In French). Dep. CFSTI (U. S. Sales Only).

Principles of both electrolytic machining (ECM) and electrical discharge machining (EDM) processes are compared. The effects of ECM on the mechanical properties of metal are reviewed. This process is influenced by a number of variables which can cause loss of accuracy. Factors affecting the interelectrode gap are also discussed. The formulas used in the calculation of metal removal rate are established from the fundamental principles of electrochemistry, e.g., Ohm's law and Faraday's law. Various applications of ECM are included and illustrated. An economical study of gas turbine blades shows that ECM excels also in large scale production. The mechanical testing of adhesive metallurgical bond between the magnesium canning and the BUGEY-type uranium fuel elements of the power reactor necessitated the trepanning of test specimens by a process which does not induce thermal effects or even cracks at the interface. A theoretical study based on the potential-pH equilibrium diagrams of magnesium and uranium-water was made in order to find the conditions under which oxidation and reduction reactions are possible in presence of aqueous solutions. The formulation of the reaction equilibria and the resulting chemical reaction produced at the anode and cathode surfaces are given. Experiments are carried out with a 500 A laboratory machine. Sodium nitrite was used as electrolyte and optimum operating parameters are determined. Factors affecting the interelectrode gap are discussed along with the electrochemistry of the process and suggestions are given. (auth) (France)

50495 (DP-Report-250) DEVELOPMENT WORK ON SIMPLE VALVES. Project DRAGON. Woodley, H. J. (Atomic Energy Establishment, Winfrith (England)). Dec 1963. 14p. (CONF-631012-15). Dep. NTIS.

From Dragon Project Engineering Symposium, Bournemouth, Eng.

The design requirements for a helium line valve for the Dragon high-temperature reactor includes: cheap and simple manufacture; high degree of leak tightness after 5000 operations at temperatures to 350°C and at helium pressures of 25 atm; and no deterioration in a radiation environment. The equipment and methods used to test valves and valve components against these specifications are described. The results of tests on modified and unmodified commercially available valves are presented. It is concluded that reliable valves can be manufactured at a reasonable cost. (L.C.L.)

50496 (N-70-26094) DESIGN STUDY FOR A MAGNETOHYDRODYNAMIC POWER SYSTEM FOR A NUCLEAR ELECTRIC PROPELLED UNMANNED SPACECRAFT. Quarterly Report, December 26, 1969–March 25, 1970. (General Electric Co., Philadelphia, Pa. Missile and Space Div.). Mar 1970. Contracts NAS7-100; JPL-952415. 30p. (NASA-CR-109614; GESP-7035). NTIS.

For Jet Propulsion Lab., Pasadena, Calif.

A nuclear–electric propelled spacecraft using a magnetohydrodynamic power system is discussed. The parametric variation of shield and structure weight is discussed as well as the effects of decreasing cycle efficiency and increasing temperature. There appears to be no strong advantage to increasing cycle temperature above about 1800°F. It was found that system weight is not directly proportional to system efficiency; weight increases with reduced efficiency are chiefly in reactor and radiator weight. (auth) (STAR)

50497 (N-70-31761) DESIGN STUDY OF A 350 kWe OUT-OF-CORE NUCLEAR THERMIONIC CONVERTER SYSTEM. Breitwieser, Roland; Lantz, Edward (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). 1970. 15p. (NASA-TM-X-52846). NTIS.

Nuclear thermionic systems with the thermionic converters outside the reactor have been reexamined in the perspective of several recent technical advances: new high temperature, corrosion resistant, high strength alloys; high heat flux heat pipes; improved thermionic converters; and lightweight, vapor-cooled radiators. These have been combined to yield a new look to the out-of-core approach. A compact reactor results; insulators are eliminated by the use of heat pipes as electrically resistive elements; and weights are reduced by combining vapor-cooled radiators, structural supports, and current leads into vapor-cooled radiator modules. The overall design is also highly modular and thus provides high reliability and a reduction in development costs. (auth) (STAR)

50498 (NYO-3839-10) EXTENDED DURATION TESTING OF A VAPOR LUBRICATED ROTOR-BEARINGS SYSTEM AND DESIGN GUIDE FOR EXTERNALLY-PRESSURIZED VAPOR BEARINGS. FINAL TOPICAL REPORT. VAPOR LUBRICA-

TION TECHNOLOGY. Firkin, E. F.; Malanoski, S. B.; Arwas, E. B. (Mechanical Technology Inc., Latham, N. Y.). Oct 1970. Contract AT(30-1)-3839. 165p. (MTI-70-TR-33). Dep. NTIS.

A 500 hour duration test was conducted using a 200 lb rotor operating at speeds of 6100, 2600, and 400 rpm, while horizontally supported on two 4" diameter, externally-pressurized, steam-lubricated journal bearings and a 7.5" diameter, double-acting, thrust bearing also externally-pressurized and lubricated with steam. A saturated supply at 90 psig was used and there was no external heating of the bearing regions to superheat the supply. The bearings design was based on earlier work and comprised a dual header arrangement that precludes condensation and steam hammer instability. The operation was completely stable and on a full fluid film. High speed rubs occurred at 6100 rpm, caused by loss of a coating chip from the thrust bearing and edge contacts in a journal bearing, induced by differential thermal expansions. The damage was limited to the contact areas and did not affect either the operation of the restrictor system or other parts of the rotor. No rubs were incurred when each bearing was allowed, through flexure mounts, to self-align with the rotor in operation. Past work in the area of vapor lubrication is briefly noted and the test equipment used and the long-term test are described. A design guide on externally-pressurized bearings is presented, and provides dimensionless charts and tables for calculation of inherently compensated, externally-pressurized vapor bearings, when phase change in the bearings is precluded. (auth)

50499 (ORNL-TM-3019) STATUS AND RECENT DEVELOPMENTS IN AGRO-INDUSTRIAL COMPLEX STUDIES. Michel, J. W. (Oak Ridge National Lab., Tenn.). 1 Jun 1970. Contract W-7405-eng-26. 33p. (CONF-700531-1). Dep. CFSTI.

From Desalination Information Meeting, Oak Ridge, Tenn.

The material on agro-industrial complexes presented at the ORNL Desalination Information Meeting, May 21 to 22, 1970 is summarized. In addition to a brief review of earlier work, the work performed during the past year is discussed along with an assessment of the future prospects for the nuclear-powered energy center concept. (auth)

50500 (PTB-1/70) CALCULATION OF THE COMPONENTS OF SCATTERED NEUTRONS AT DIFFERENT MEASURING LOCATIONS IN A LABORATORY BEING DESIGNED FOR THE NEUTRON DOSIMETRY BUILDING AT THE FEDERAL INSTITUTE FOR ENGINEERING PHYSICS. Schoelermann, H. (Physikalisch-Technische Bundesanstalt, Brunswick (West Germany)). Mar 1970. 31p. (In German). Dep. NTIS (U. S. Sales Only).

The background of scattered neutrons in a laboratory which is being designed was investigated theoretically. The influence of different experimental arrangements of targets, detectors and shielding on the flux of scattered neutrons was calculated and discussed under simplifying assumptions. (tr-auth)

50501 (SGAE-PH-93/1970) DEVELOPMENT OF A PLASMATRON ION SOURCE WITH SLIT GEOMETRY FOR AN ELECTROMAGNETIC MASS SEPARATOR. Winter, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Institut). 1970. 83p. (In German). Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Technische Hochschule, Vienna, Austria.

A plasmatron ion source with slit geometry, especially suitable for the production of rare gas ions, was developed and constructed for the Seibersdorf electromagnetic mass separator. With the help of probe measurements in the internal and external plasma of the ion source, the principal modes of operation of the plasmatron ion source were experimentally verified. After an extensive investigation of the methods used for the characterization of the beam quality of intensive ion beams and of the factors causing beam quality deterioration, it was shown that with the help of the concepts of emittance and brilliance only clear assumptions on the effect of the ion source on the separation power obtainable could be made. On the basis of a simple model of ion extraction from the meniscus of the plasmatron ion source, data were given on the possible heights of the ion currents, reported on the basis of the size of the permissible beam aperture angle, the ion mass, and the length of the emission slit. These data were reported on the assumption of the highest possible extraction voltage gradient between emission slit and extraction screen. Studies of the energy distribution of the extracted ions gave in most cases values with the half-value width of 25 eV, in which the form and size of the energy distribution are strongly dependent on the type of operation of the ion source. There is a strong dependence of the total efficiency on the width of the emission slit; its optimum value is determined by the gas used. It was established that the oscillation susceptibility of the ion source plasma and therefore the degree of beam space charge compensation are dependent on the slit shape. In addition to the occurrence of hash, plasma acoustic oscillations were detected in which the oscillation susceptibility increases with increasing ion mass. By optimization of the emission slit width a total efficiency of over 50% could be obtained for argon. By the use of nickel interoxide cathodes continuous operation for periods of more than 100 hrs at full power was possible; the total power need of the plasmatron ion source is less that 150 W. (tr-auth)

50502 BROOKHAVEN PORTABLE CESIUM DEVELOPMENT IRRADIATOR (BPCBI) (Jan 1970) (Engineering Materials). (Brookhaven National Lab., Upton, N. Y.). (CAPE-2029).

1 drawing.

A self-contained Pb-shielded food irradiation unit weighing ~19 tons and occupying ~72 ft^2 of floor space that uses the "moving source" principle is described. The source moves from its storage cask into the irradiation chamber and back with each irradiation cycle eliminating a package-carrier system. The 100,000 Ci source consisting of 28 BNL ^{137}Cs sources, arranged horizontally in two source plaques, covers an area of 19 by 27 in. The source is stored in a Pb-shielded cask which is attached to the irradiation chamber during operation, but is also used as a shipping cask. Usable space in the chamber consists of two 8 in. high cavities ~27 in. wide and 54 in. long. Lead-shielded doors provide access to the chamber. For semi-production continuous flow operation, the side wall opposite the doors can be removed; however, the irradiator must then be used in a shielded room or labyrinth. Doors are operated by ball-bearing Pb screws and the source plaque is moved back and forth in a horizontal plane by means of a motorized jack screw. Mechanical and pneumatic interlocks monitor movement of the source plaque and the doors to prevent accidental operator exposure. The irradiation chamber and source cask are mounted on a 2 ft high structural steel base which is strong enough to carry the weight of the unit, or to anchor the unit to a moving platform. (See also CAPE-1891) (For details see TID-4100 Suppl. 61) (F.S.)

50503 COMPUTATIONS RELATIVE TO VESSELS USED IN NUCLEAR INSTALLATIONS. PART III. A THERMIC TRANSIENT. Surace, Giuseppe (Politecnico, Turin). Termotecnica (Milan); 24: 326-31(Jul 1970). (In Italian).

A method of deriving the formulas relative to the calculation of stress in a shell, a joint of large curvature, and a joint of any form subject to axisymmetric situations, in case of a thermal load varying with time, whose cause may be of external or of internal nature due to heating production in the thickness of the shell, is presented. (auth)

50504 COST OF PURIFYING TURBINE CONDENSATE IN NUCLEAR POWER PLANTS. Brusakov, V. P.; Barbashinov, I. M.; Rybal'chenko, I. L. Teploenergetika; No. 1, 62-3(1970). (In Russian).

A method for chemically purifying nuclear power plant turbine condensate using ion exchange filters with a mixed load of ionites and using high speed filtration and regenerated waste was tested, and indicated the economic feasibility of this method of turbine condensate purification. (tr-auth)

50505 BOILER DEVELOPMENTS IN THE USA. Kessler, G. W. Mitt. Ver. Grosskesselbetr.; 49: 244-62(Aug 1969). (In German).

Recent developments in the boiler industry in the USA are reviewed and economic factors such as the influence of nuclear power, costs of preventing air pollution, and fuel transportation are discussed. Technological factors considered include the increases in steam temperature and steam pressure. New developments are towards new alloys with improved fabricability and weldability, higher strength, and better service behavior. Other developments briefly mentioned concern precautions to prevent erosion in turbines and fuel oil and coal-ash corrosion. (Metals Abstr.)

50506 VENTILATING SYSTEMS AND DEVICES FOR LABORATORIES AND WORKING ROOMS WHERE UNSEALED RADIOACTIVE MATERIAL IS HANDLED. Hamel, P. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Isotopenpraxis; 6: 161-70 (May-Jun 1970). (In German).

The ventilation equipment and methods required for the safe operation of laboratories and other facilities where unsealed radioactive material is handled are discussed with emphasis on the air intake systems, air exhaust systems, filtering methods, and process instrumentation and control system. Since the ventilation requirements will affect the arrangement and overall design and construction of such facilities, they must be considered in the initial design phase. (L.C.L.)

50507 NEW LOOK OF ULTRASONIC MACHINING. Dallas, Daniel B. Mfg. Eng. Manage.; 64: No. 2, 40-2(Feb 1970).

Drilling, milling, grinding, and threading can be performed ultrasonically on high-alumina ceramics, technical ceramics, ferrites, porcelain, glass, B/W laminates, and Be with a new machine that utilizes ultrasonic energy to impart vibration to a rotating cutting tool, usually diamond. The difference between this machine and the now-conventional impact ultrasonic machine tool is that the cutting tool is simultaneously vibrating axially and rotating. It is especially suitable for fast, efficient machining of brittle, superhard materials. (Metals Abstr.)

50508 METHODS AND APPARATUS FOR MEASURING SLURRY DENSITY WITH GAMMA RAYS. Zimmerman, Carl W.; Wilson, Robert O. (to Halliburton Co.). U. S. Patent 3,529,153. 15 Sep 1970. Filed 15 May 1968.

Method and apparatus for measuring the density of a slurry including diverse solid materials are discussed. One solid material has a cation having an atomic number on the order of 38 or higher, while another solid material has a cation with an appreciably lower atomic number. High-energy primary photons are passed through the slurry. Low energy photons generated by multiple Compton scatterings are substantially blocked or attenuated as they issue from the slurry. The photons which successfully penetrate the blocking and attenuation are impinged upon scintillation counter. The discrimination level of the scintillation counter is adjusted to detect photons having an energy level substantially lower than that of the primary photons which impinge upon the counter and maintain maximum operating stability for the counter. (auth)

50509 MKW ROLLING MILL: ITS DEVELOPMENT, APPLICATION, AND POSSIBILITIES. Heifeld, Klaus; Reinstaedtler, Richard. Metalurgia (Sao Paulo); 25: 775-85(Oct 1969). (In Portuguese).

A multiple-roll cold rolling mill is described. It is a four-high mill with driven back-up rolls and work rolls that are, on the average, some 60% smaller than those of conventional mills. Engineering and operating features and performance are discussed in detail. These mills have been built in various sizes and with roll sets of different numbers to roll C, alloy and stainless steels, Cu, brass, bronze, Al, and Al alloys and special alloys based on Mo, Ni, Ta, Nb, and Ti. One installation in the U.S. is a duplex mill (the roll set comprises 16 rolls) used to process extremely hard thin strip. As part of a projection of future applications of such mills, which thus far have been reversible, their advantages to multiple-stand, nonreversible rolling lines are pointed out. The rolling of steel and nonferrous sheet at very high pass reductions is also being studied. (Metals Abstr.)

Heat Transfer and Fluid Flow

Refer also to abstracts 50505, 51133, 51149, 51208, 51869, 52781, 52910, and 52913.

50510 (AEC-tr-7162) INSTITUTE OF HIGH TEMPERATURES, USSR ACADEMY OF SCIENCES. COMPILATION OF THE MOST SIGNIFICANT RESULTS OF THE SCIENTIFIC-RESEARCH WORKS OF 1969. Translation of Institut Vysokikh Temperatur Akademii Nauk SSSR. Vazhneyshiye Rezul'taty Nauchno-Issledovatel'skikh Rabot 1969 Goda, Izdatel'stvo Nauka, Moscow, 1970. 73p. Dep. CFSTI.

The USSR Institute of High Temperatures is described and results of research on properties of matter at high temperatures, heat transfer, gas dynamics, hydrodynamics, heat resistant structural materials, and direct energy conversion are summarized. (J.R.D.)

50511 HEAT TRANSFER FROM FREELY FLOWING BOILING POTASSIUM. Shevchuk, E. N. (Inst. of Engineering Thermal Physics, Kiev). Teplofiz. Teplotekh.; No. 15, 76-81(1970). (In Russian).

Data are given on results from an experimental investigation of heat transfer from a large amount of boiling K under its own vapor pressure. Methods are recommended for calculating the heat transfer from bubble boiling K under free convection conditions. (tr-auth)

50512 BOILING CRISIS WITH PARALLEL FLOW IN FUEL ROD BUNDLES. Tolubinskii, V. I.; Mazka, S. A.; Vasil'ev, A. A. (Inst. of Engineering Thermal Physics, Kiev). Teplofiz. Teplotekh.; No. 15, 5-10(1970). (In Russian).

Domestic and foreign literature on critical heat transfer with parallel flow past fuel rod bundles was evaluated. The influence of different geometries of multirod assemblies on the magnitude of the critical heat flow was analyzed. (tr-auth)

50513 LAMINAR-FLOW HEAT TRANSFER FOR IN-LINE FLOW THROUGH UNBAFFLED ROD BUNDLES. Dwyer, O. E.; Berry, H. C. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng.; 42: 81-8(Oct 1970).

The findings of a theoretical study of heat transfer for laminar, in-line flow through unbaffled rod bundles are reported. The results of a numerical solution are given for equilateral triangular bundles, for P/D ratios ranging from 1.001 to 2.00, for fully developed temperature profiles, and for the thermal boundary conditions of uniform wall heat flux in all directions. They are given in terms of rod-average heat transfer coefficients and circumferential variations of the wall temperature. The rod-average heat transfer coefficient goes through a rather sharp maximum as the P/D ratio is varied, the maximum occurring at P/D = 1.20. The circumferential variation of the wall temperature, large at small P/D ratios, decreases as P/D is increased, until at P/D > ~1.50 it is negligible. Results calculated for the thermal boundary conditions of uniform wall heat flux in the axial direction and uniform wall temperature in the circumferential direction agreed excellently with previous results, attesting to the accuracy of the present calculational method. (auth)

50514 GEOMETRY FOR EFFICIENT EXTERNAL AND INTERNAL COOLING OF CYLINDRICAL HEAT SOURCES. Melese-d'Hospital, G. (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Sci. Eng.; 42: 64-8(Oct 1970).

A unique geometry is found for a heat generating cylindrical rod cooled on both sides within a coolant channel, which leads to the same coolant temperature and the same surface temperature on both sides of the rod. The optimum rod id/od is close to one-half and the corresponding overall void fraction near 57% for cylindrical, hexagonal, or square channel configurations. (auth)

Isotope Technology

Refer also to abstracts 50463, 50464, 50502, 50540, 51236, 52866–52872, 52875–52883.

50515 (BNL-tr-364) APPARATUS FOR EXTRACTION OF RADIOACTIVE ARGON FROM A CHLORINE-CONTAINING SUBSTANCE. Gavrin, V. N.; Kalinnikova, I. A.; Pomanskii, A. A.; Severnyi, S. A. Translated by S. J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from Kosm. Luchi; No. 10, 20-2(1969). 5p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 46332.

50516 (CEA-N-1323) A DEVICE FOR POSITIONING THE ELECTRODES OF AN ISOTOPE SEPARATOR COLLECTOR AND FOR CONTROLLING THE SHAPE AND INTENSITY OF THE ION BEAM. Porru, Romain; Choulet, Serge; Ristori, Christian (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Sep 1970. 9p. (In French). Dep. CFSTI (U. S. Sales Only).

A remote control device for positioning the collector electrodes of an electromagnetic isotope separator is described. The electrodes are used for oscillographic observation, beam stabilization, and intensity measurement. These electrodes are moved in the collector by an endless screw and their position transmitted by a set of Selsyns to the separator control desk. (auth) (France)

50517 (CONF-690916-(Vol.2), pp 121-8) PRODUCTION OF TRITIUM TARGETS AND SOURCES. Indra, R. N.; Kulkarni, B. A. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. II.

Work undertaken to develop the production of tritium sources in India is described. Zirconium is deposited on copper discs by vacuum evaporation. The zirconium layer is impregnated with tritium by heating the disc in a tritium atmosphere. The activity of the tritium source is evaluated from the observed pressure decrease in the impregnating chamber. (auth)

50518 (DP-1247) SAVANNAH RIVER LABORATORY ^{60}Co POWER AND HEAT SOURCES. Quarterly Progress Report, April-June 1970. Angerman, C. L.; Ross, C. P. (comps.) (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Aug 1970. Contract AT(07-2)-1. 30p. Dep. NTIS.

The purpose of the program to provide data that will be required for designing, fabricating, and operating ^{60}Co heat sources with emphasis on the fabrication and testing of capsules and establishing temperature limits for operation of capsules is discussed. The following progress was made: rhenium and tungsten-25% rhenium capsules for long-term heating tests were TIG-welded satisfactorily. Most tungsten welds still were not crack-free. Design work was begun on vacuum furnaces and other equipment for the

new shielded ^{60}Co capsule test facility. Temperature excursions in simple ^{60}Co heat sources during some fire and burial conditions were calculated. Testing under these conditions is being planned. Haynes 188 was proposed as the outer capsule material for the 30 kW(t) demonstration unit, based on oxidation and compatibility tests. The two highest power ^{60}Co capsules ever made were fabricated to fuel the 3 kW(t) demonstration test with thermoelectric power conversion. (L.C.L.)

50519 (NUMEC-3731-17) RELIABILITY STUDY AND TEST PLAN FOR PHASE II. Radioisotope-Powered Cardiac Pacemaker. Kolenik, Steve A.; Marino, Kenneth R. (Nuclear Materials and Equipment Corp., Apollo, Pa. Energy Conversion Div.). 15 Aug 1969. Contract AT(30-1)-3731. 45p. Dep. CFSTI.

Phase II of the Radioisotope-Powered Cardiac Pacemaker Program is concerned with developing procedures for testing the device against a specification of 95% reliability for 11-yr life at 90% confidence. The amount of time and number of test units required to prove this objective are compared with the time and units needed to prove a reliability better than that of the mercury battery-powered pacer. The test methods proposed for determining the performance of both the assembled pacer and its components are evaluated. The statistical formulas and calculations used to predict the test requirements needed to prove the pacer reliability are presented. (L.C.L.)

50520 DETERMINATION OF CONTENT AND DISTRIBUTION OF FILLER AND COATING MATERIALS IN PAPER USING RADIOISOTOPE X-RAY SPECTROMETRY. Kuusi, J. (Helsinki Univ. of Tech., Otaniemi, Finland). Pap. Puu; 52: No. 4a, 145-51; 154-8(1970).

Laboratory measurements carried out for the development of methods for determination of the content and distribution of filler and coating materials in paper using radioisotope x-ray spectrometry are described. Eight possible radiation sources for radioisotope x-ray analysis with the half-life of each, type and energy of principal radiation, typical activity, and preferential applications are tabulated. Five types of feasible detectors with information on their energy resolution, applicability to on-line measurements, price, and typical potential applications are given in a table. Both fluorescence and absorption measurements in the case of uncoated papers, containing either china clay or talc as filler material or calcium, titanium or heavier elements in their filler materials, are described. X-ray fluorescence techniques used with coated papers are presented. Results showed that in certain cases measurements may be carried out even under on-line conditions using relatively simple instrumentation so that information is obtained immediately and may be used directly for process control. (Finland)

50521 METHOD FOR THE CALCULATION OF FIELD DOSE OF A URANIUM RADIATION LOOP LINEAR SOURCE OF γ-RADIATION. Stariznyi, E. S.; Breger, A. Kh. This paper was summarized in At. Energ. (USSR); 26: 451-2(May 1969) as paper No. 293. (In Russian).

A promising use of uranium radiation loops (URL) as intense and economic sources of γ-radiation is discussed. For practical realization of URL an important consideration is the distribution of the absorption dose in the reacting volume (uniformity of radiation of the object). Relations for the calculation of field doses in the reacting volume of a URL with a linear source are summarized. It is assumed that the relation between the specific power of the γ-radiation from the fuel at the time t after its exit from the active zone of the nuclear reactor and the thermal power can be written as a quadratic trinomial. Such a representation is possible within the accuracies required for practical purposes. In this case the energy flux from a linear URL source at a point located in the medium with linear attenuation coefficient μ, and using a build-up factor in analytical form, is determined by an integral. The mathematical relations permit the calculation of the field of the absorbed dose in the irradiator for various geometries with finite numbers of linear URL sources such as planes, cylinders, and lattices. (auth)

50522 TWO METHODS OF DECREASING THE INHOMOGENEITY OF THE DOSE FIELD ALONG RADIATION SOURCE. Stariznyi, E. S.; Breger, A. Kh. At. Energ. (USSR); 28: 255-6(Mar 1970). (In Russian).

It is noted that radiation flux decreases from the place of its entry into a source until it leaves the source. Thus, the dose field is inhomogeneous, and ways of decreasing the inhomogeneity is desirable. One method involves irradiation from two sides to equalize the dose field. Another method involves varying the radiator with a change in direction. Both methods are applicable to sources of different geometry, and the two methods can also be used simultaneously. (TTT)

50523 QUANTITATIVE METHOD FOR DETERMINING THE WEIGHT PER UNIT AREA OF COATINGS APPLIED TO PAPERS. Rutledge, Wyman C. (to Mead Corp.). U. S. Patent 3,525,865. 25 Aug 1970. Filed 23 Mar 1966.

A method is described for quantitatively measuring the weights of paper coatings by use of the "backscattering" effect of beta rays directed onto the coating applied on a cellulose base and under which is placed a backing sheet of infinite thickness. The difference between the count rate of backscattered beta rays for coated and uncoated paper of the same composition represents a measure of the weight of coating on the coated paper, when compared with calibration curves for each formulation of coating material. (auth)

50524 ISOTOPES AND RADIATION TECHNOLOGY. VOLUME 8, NUMBER 1. Baker, P. S.; Lafferty, Robert H. Jr.; Gerrard, Martha; Greene, R. E.; McKinney, F. E.; Raaen, Helen P. (eds.). One of Four Quarterly Technical Progress Reviews Published for the Division of Technical Information, USAEC. Oak Ridge, Tenn.; Oak Ridge National Lab. (Fall 1970). 140p. GPO $0.70.

Twenty-two articles are included in eight sections; separate abstracts were prepared for 14. The remaining 8 papers contain information on: radioisotope methods of analysis and characterization of elastomers; radiochemical study of the diffusion of ions through protective films; radioisotopic gage for width control; French cardiac pacemaker; uses of isotopes in metabolic studies with soil microorganisms; availability of isotopes and services; AEC activities; and general. (P.C.H.)

For abstracts of individual papers see: 50360, 50421, 50422, 50525, 50533, 50534, 50540, 50649–50651, 50825, 50984, 51121, and 51122.

50525 ISOTOPES IN AUSTRALIA, JULY 1, 1968–JUNE 30, 1969. Isotop. Radiat. Technol.; 8: 124-5(Fall 1970).

The production of radioisotopes by the Australian AEC from July 1968 to July 1969 is discussed. Tabulated data on the types of radioisotopes produced, total number of items produced, and dollar value for each of five categories of radioisotope applications is presented. By July 1969, shipments of Australian-produced radioisotopes averaged more than 400 items per month with a total income from sales of $236,039, more than double that of the previous year. (L.C.L.)

50526 PROCEDURE FOR STIRRING ALIQUOTS OF RADIOACTIVE SOLUTIONS WHEN MAKING THIN 4π COUNTING SOURCES. Wyllie, H. A.; Johnson, E. P.; Lowenthal, G. C. (Australian Atomic Energy Commission, Lucas Heights). Int. J. Appl. Radiat. Isotop.; 21: 497-9(Aug 1970).

It is stated that when aliquots are evaporated on metallized plastic films to produce radioactive sources the residue tends to crystallize in a nonuniform manner and this nonuniformity must be minimized by suitable treatment. The irregular crystal growth is due largely to nonhomogeneous conditions prevailing during drying. It was demonstrated that the counting efficiency of ^{54}Mn and ^{60}Co sources could be much improved if the conventional oven drying was replaced by stirring and drying the aliquots with a jet of warm N_2. The apparatus used is shown diagrammatically. The results are restricted to ^{54}Mn and ^{60}Co sources since the efficiencies of these nuclides can be measured reliably and accurately by the $4\pi\beta$-γ coincidence method. The wetting agent, Catanoac, was employed in the preparations. (UK)

50527 COMBINED RADIOISOTOPE POWER AND PROPULSION SYSTEM. Sitney, Lawrence R. U. S. Patent 3,528,245. 15 Sep 1970. Filed 27 May 1968.

A combined power and propulsion system for a manned space vehicle which utilizes the heat generated by a radioisotope heat source for heating a working fluid and a propellant is described. The system is also capable of exhausting biowaste products in order to achieve additional useful thrust and to further enhance the spacecraft performance. (auth)

50528 DEPLOYABLE RADIOISOTOPIC THERMOELECTRIC GENERATOR. Linkous, Guy F.; Dick, Paul J. (to Teledyne, Inc.). U. S. Patent 3,530,009. 22 Sep 1970. Filed 20 Oct 1967.

A thermoelectric generator for use with space vehicles and satellites is described. The generator uses a flat, rectangular shaped radioisotopic heat source which is positioned between two parallel banks of interconnected thermoelectric elements. The paddle shaped assembly is deployable from a thin arm extending from a satellite. Heat deriving from the radioisotopic heat source passes through the inward facing ends of the thermoelements to be dumped from radiating panels forming the opposed outer sides of the paddle shaped structure. (auth)

50529 METHOD AND APPARATUS FOR DETERMINING EXCESS TEMPERATURE OF A MACHINE COMPONENT BY THE USE OF AN INERT RADIOACTIVE GAS. Eddy, William C. Jr. (to Industrial Nucleonics Corp.). U. S. Patent 3,530,297. 22 Sep 1970. Filed 8 Aug 1966.

A method and apparatus for detecting when a component part within a machine is operated at a temperature in excess of a predetermined maximum safe temperature includes incorporating an inert radioactive gas such as ^{85}Kr interstitially within one or more selected parts, preheating the treated parts to the predetermined temperature, the operation above which may cause the part to fail, to release a quantity of the radioactive gas until no further gas is released at or below that temperature. The treated parts are installed within the machine. The presence of released radioactive gas indicates that the temperature of a part has subsequently exceeded the predetermined temperature and that the safe temperature of a part has been exceeded. (auth)

50530 RADIONUCLIDES FOR INDUSTRIAL APPLICATIONS. Baker, P. S. (Oak Ridge National Lab., Tenn.). pp 501-70 of Handbook of Radioactive Nuclides. /Wang, Yen (ed.). Cleveland; Chemical Rubber Company (1969).

The characteristic effects of radiation and the availability of radioisotopes are briefly summarized. Industrial uses of radioisotopes are classified generally as applications for tracing, gaging, radiography, ionizing radiation, and heat and power production. Ten papers on specific applications of radioisotopes in the following industries are presented: aerospace and other environmental uses; agriculture; chemical processing; consumer-products, such as foods, textiles, etc.; crude petroleum and natural gas; electrical; metals; mining; transportation equipment; and utilities. (L.C.L.)

Materials Testing

Refer also to abstracts 50503, 50524, 52245, and 52969.

50531 (CONF-671061-(Vol.3)) PROCEEDINGS OF THE 4th CONGRESS FOR MATERIALS TESTING. III. NONDESTRUCTIVE TESTING, BUDAPEST, 11-14 OCTOBER 1967. (Scientific Society of Mechanical Engineers, Budapest (Hungary)). 839p. (In German and English).

A separate abstract was prepared for each of 2 of the 31 papers presented. The remaining 29 papers were not within the scope of NSA. (W.H.K.)

For abstracts of individual papers see: 50532 and 52245.

50532 (CONF-671061-(Vol.3), pp 907-15) LEAK TESTING IN NUCLEAR ENERGY INSTALLATIONS. Kittner, Manfred (VEB Kombinat Kernenergetik, Berlin). (In German).

The bases for the leak specifications of nuclear installations are summarized. The leak rate is defined and the relation between leak mass and leak volume is given. The relation between the leak masses of air and water is also considered. The detection sensitivity of testing methods is compared, and practical examples of the uses of these methods are given. (J.S.R.)

50533 PORTABLE NEUTRON RADIOGRAPHIC CAMERA USING ^{252}Cf. Shaw, C. B.; Cason, J. L. (Battelle-Northwest, Richland Wash.). Isotop. Radiat. Technol.; 8: 69-74(Fall 1970). (BNWL-SA-3090).

A first-generation portable neutron camera using ^{252}Cf as the source of neutrons was developed and constructed and is being used in studies on applications. Work to date indicates that a satisfactory neutron dose can be delivered at the object position with satisfactory resolution capability. The entire device—including containment, moderation, collimation, and control systems—is portable. (auth)

50534 SAFETY TESTING OF RADIOISOTOPIC GAGES AND RADIOGRAPHY UNITS. Isotop. Radiat. Technol.; 8: 114-17 (Fall 1970). (ORO-3610-1).

Studies were made on the construction and performance, under simulated field conditions, of four radiography units designed for use with ^{60}Co or ^{192}Ir sealed sources ranging from 10 to 100Ci and of nine radioisotopic gages designed for use with ^{137}Cs, ^{60}Co, ^{85}Kr, ^{226}Ra, or ^{90}Sr. The results of the tests and recommendations for standard testing procedures are reported. (auth)

Radioactive Material Handling

Refer also to abstracts 50492, 50506, and 50950.

50535 (ARH-SA-71) PLANT APPLICATION OF NUCLEAR CRITICALITY PREVENTION PRINCIPLES. Nicholson, G. A. (Atlantic Richfield Hanford Co., Richland, Wash.). 1 Jul 1970. Contract AT(45-1)-2130. 15p. (CONF-701103-2). Dep. NTIS.

From 63rd National Meeting of the American Institute of Chemical Engineers, Chicago, Ill.

A primary concern in the design and operation of a nuclear fuels processing plant is the prevention of an uncontrolled nuclear chain reaction, or nuclear criticality excursion. Effective plant application of criticality prevention principles should commence with process flowsheet design and continue through equipment and facility design and construction. Safe and successful plant operation requires that criticality prevention principles and practices be accorded paramount consideration by all members of the production and support teams. (auth)

50536 (BNL-50250) FEASIBILITY OF UTILIZING A MICROTRON ELECTRON ACCELERATOR FOR NUCLEAR MATERIALS ASSAY. Beyster, J. R. (Brookhaven National Lab., Upton, N. Y.). Jun 1970. 26p. Dep. CFSTI.

Results of an investigation aimed at identifying a type of accelerator capable of performing neutron and gamma interrogation are presented. An evaluation of accelerators is presented including machine operation, strong points and limitations of the machine, and recommendations. (J.R.D.)

50537 (BNL-50251) EVALUATION OF REACTIVITY METHODS OF NUCLEAR MATERIALS ASSAY. Beyster, J. R. (Brookhaven National Lab., Upton, N. Y.). Jun 1970. 34p. Dep. CFSTI.

Results of a critical evaluation of the reactivity method indicate that it is not a very promising approach to nuclear materials assay for safeguards purposes. The analysis revealed that the apparatus (a critical or subcritical assembly) is relatively costly (>$150,000), is not transportable, is bulky, requires licensing, criticality safeguards analysis, and very specially trained operating personnel. Operating costs would also be relatively high compared with other active methods. The assay procedures using this device are multistep and time-consuming. The analysis of the data, especially with fluctuating fissionable isotopic content or absorber content, requires great care. The method at present essentially uses thermal neutrons as the probe. The low-energy neutrons have low penetration, and selfshielding is important. Thus, the variety of fuel and sample configurations which can be examined with the method is limited. Scrap and irregular shapes cannot be examined. Methods of discrimination between ^{239}Pu and ^{235}U have not been completely resolved and are most difficult to apply. The method gives accurate results for regular fuel shapes using standards, but the accuracies are, at best, comparable with those from other newer methods, i.e., one to three gram accuracies. Deception is harder to detect using this method, since one is measuring an integral quantity. (auth)

50538 AEC'S POSITION ON RADIOACTIVE WASTE MANAGEMENT. Belter, W. G.; McVey, W.; Bartlett, C. B.; Mattern, K. L.; Regan, W. H. (Atomic Energy Commission, Washington, D. C.). Nucl. News; 12: No. 11, 60-5(Nov 1969).

The status of present technology related to liquid high-level radioactive waste tank storage, solidification, transportation, and ultimate disposal is reviewed. Discussions are included on disposal in geologic salt formations, limitation of disposal repositories, determination of allowable interim storage time, and disposal of hot fuel cans. (J.R.D.)

50539 MEASUREMENTS OF NEUTRON DENSITY HYPERFINE DISTRIBUTION IN UO_2 FUEL ELEMENTS. Accinni, F. (CISE, Milan); Bozzi, L.; Corberi, A.; Mangialajo, M. Energ. Nucl. (Milan); 17: 541-4(Sep 1970).

Three techniques for measuring neutron density distribution in power reactor fuel elements were compared. The first consists in γ-counting the fission product activity in pins obtained from the fuel pellets; the second in the measurement of β activity in Al-Dy wires irradiated inside the fuel element; the third in γ-counting copper pins obtained by a photo-fabrication procedure from copper disks irradiated between the fuel pellets. The comparison of these techniques was performed with measurements in a UO_2 cluster of the CIRENE-type, inserted into the TOPLESS subcritical assembly. (auth)

50540 FRENCH FACILITY FOR FABRICATION OF SEALED RADIOISOTOPIC SOURCES. Isotop. Radiat. Technol.; 8: 121-2(Fall 1970).

The design and operation of the facility at Saclay, France for fabricating radioactive sources, particularly ^{137}Cs, ^{90}Sr, ^{147}Pm, and ^{144}Ce, are described. Procedures used for material transfer, handling of radioactive and uncontaminated waste, and ventilation are discussed. Large amounts of radioactive material can be processed, e.g., ? to 3 kg of ^{137}Cs, each radioisotope being processed in a separate cell. (L.C.L.)

Vacuum Engineering

50641 RESIDUAL ATMOSPHERE ANALYSIS AND APPLICATION TO THE STUDY OF ION PUMPING ON THE HIGH PRESSURE ALUMINUM ALLOY ENCLOSURE OF A DIFFERENTIAL VACUUM SYSTEM. Paletto, S.; Perdrix, M.; Goutte, R.; Guillaud, C. (Institut National des Sciences Appliquees, Villeurbanne, France). Vide; No. 146, 91-3(Mar-Apr 1970). (In French).

The differential vacuum apparatus used to analyze the mass and the speed of the negative ions emitted by a metal target under ionic bombardment was described. Ion pumping by a getter ion pump connected up in series with a titanium evaporation cell, on the high pressure enclosure whose walls were made of light alloy, was tested. The residual atmosphere did not differ very much from that of the stainless steel enclosures. Moreover, the study of the titanium sublimation pump revealed that during sublimation, the filament gave out hydrogen and that by modifying the sublimation cycle, it was possible to increase momentarily the pumping speed to bring the pressure to a defined value. (auth) (France)

50642 OIL-FREE EVACUATION OF LARGE VOLUMES TO 10^{-13} TORR BY CRYOGENIC PUMPS. Yuferov, V. B.; Kobzev, P. M.; Glasov, B. V. Sov. Phys.-Tech. Phys. (Engl. Transl.); 15: 457-62(Sep 1970).

Translated from Zh. Tekh. Fiz.; 40: 592-9(Mar 1970).

The oil-free evacuation of a volume of 800 liters from atmospheric pressure by cryogenic pumps is described. In a time of about 2 hr a volume bounded by walls at a temperature of 5°K is evacuated to 10^{-13} torr; this pressure is achieved by sorption of helium on layers of condensed gases and vapors. The pressure inside a cryopanel at a temperature of 20°K is 6×10^{-11} torr after 1.5 hr, also achieved by cryogenic pumps. It is shown that to produce such pressures in volumes bounded by cold walls they need not be hermetically sealed if the volume is contained inside a protective vacuum. The speed of cryosorption of helium on the surface of the cryopanel on which there is a condensed layer of argon at 5°K is 10^5 liters/sec. The electric power consumption required to maintain the pressure in the system at 10^{-13} torr is $\sim 4 \times 10^{-4}$ Kwh/(liter/sec). (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstract 50396.

General Detectors and Monitors

Refer also to abstracts 50895, 50901, 50917, 51717, 51813, and 52761.

50543 (AAEC/TM–541) MEASUREMENT OF THE FISSION TRACK RECORDING EFFICIENCY OF MICA. Wall, T. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1970. 18p. Dep. NTIS (U. S. Sales Only).

A value for the fission track recording efficiency of mica, of 0.919 ± 0.019 relative to ^{197}Au reaction rate, was obtained. This was considered to agree with values obtained elsewhere, and was verified by a comparison of fission rates measured with a fission counter and with a solid state track recorder. (Australia)

50544 (AD–707095) FANO FACTOR FACT AND FALLACY. Zulliger, H. R.; Aitken, D. W. (Stanford Univ., Calif. High-Energy Physics Lab.). Mar 1970. Contract F44620-69-C-0042. 18p. (HEPL–624). NTIS.

By definition, the Fano factor (F) is an intrinsic material constant which reflects the ultimate detector resolution. The paper points out the difficulties associated with Fano factor measurements; attempts to clarify the mechanisms of some apparently anomalous behavior frequently observed in solid state detectors; presents some new experimental results for F in silicon and germanium; and derives a phenomenological model for the average energy expended to produce an electron-hole pair (epsilon), which is then used to predict semitheoretical values of F. (USGRDR)

50545 (CERN–70–25) TWO TRIPLE TWOFOLD GATED COINCIDENCE UNITS. Nanni, F.; Verweij, H. (European Organization for Nuclear Research, Geneva (Switzerland)). 15 Sep 1970. 26p. Dep. NTIS (U. S. Sales Only).

Two coincidence units, types N6235 and N6237, are described. They both contain three independent twofold channels which can be gated by one common signal. They have been designed to operate with standard NIM signal levels (–800 mV = "1", 0 mV = "0"). The two units have identical input AND-gates and gate circuitry, but they have different output facilities. The type N6235 has an output shaper and provides output signals of standard width (8.5 nsec). The type N6237 delivers output signals that have a width equal to the time overlap of the input signals. The minimum resolving time of the instruments is ≤1.5 nsec and the minimum gate width ≤2.5 nsec. The units are part of the CERN-NIM compatible nucleonic instrument range. (auth)

50546 (CONF–691212–, pp 115-32) WHOLE-BODY COUNTING. Orvis, Alan L. (Mayo Clinic, Rochester, Minn.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

Representative whole-body counters vary in their counting characteristics. Large-volume organic detectors are the most sensitive but have poor energy and spatial resolution characteristics. Scanning systems, particularly those with shadow shields, are relatively inexpensive and combine the advantages of good energy resolution, some spatial resolution, and minimal variation of response due to radioisotope distribution. The Brookhaven multicrystal array adds to those advantages computer processing of data and advanced calibration techniques. The selection of optimal parameters of operation is important. Accurate measurements of body burden and tracer turnover are possible in individual subjects, but conversion of these data to rad dose requires additional data. (auth)

50547 (LNF–70/13) EFFICIENCY OF A TELESCOPE WITH A PLASTIC COUNTER AND LEAD CONVERTER FOR DISCLOSURE OF PHOTONS. Note No. 471. Capon, G.; Locci, M. A.; Murtas, G. P.; Penso, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 24 Mar 1970. 39p. (In Italian). Dep. CFSTI (U. S. Sales Only).

A theoretical and experimental study is made of the detection efficiency for photons with energy between 50 and 1500 MeV of a device constituted on a series of plastic scintillators interspersed with lead shields. The experimental device is described in detail, and the Monte Carlo method used for the theoretical study of the efficiency is discussed. The experimental and theoretical results are compared and show that corrections in the theoretical calculations are necessary for the production of pairs and for low energy photons which can yield Compton electrons. These corrections give good results except in the case of very thick shields when the theoretical values can only be considered as indicative. (J.S.R.)

50548 (N–70–20649) RUGGEDIZED GAMMA RADIATION DETECTOR. Final Report. Carrell, T. E. (North American Rockwell Corp., Los Angeles, Calif.). 23 Sep 1969. Contract NAS8-20840). 74p. (NASA-CR–102509; NA–69–609). CFSTI.

A description of the design, fabrication, and testing effort conducted to provide a prototype gamma radiation detector capable of operating in the severe environment that will be encountered in the vicinity of a nuclear powered rocket engine is presented. The detector is based on currents produced by Compton scattering in a dielectric material. The technical discussion centers on the theory of detector operation, specific details of fabrication and the results of performance qualification testing. The ruggedized gamma radiation detector is designed to measure gamma radiation intensities in the range of 100,000 to 10 to the 7th power roentgens/hour in a space, ambient and liquid helium environment. It is a self powered device that is capable of operating in a high neutron field, and under extreme conditions of shock and vibration. The three prototype detectors developed have successfully demonstrated compliance with all of the technical requirements. (auth) (USGRDR)

50549 (NP–18411) USE OF CELLULOSE NITRATE FOR ALPHA-PARTICLE DETECTION. Anno, Jacques (Toulouse Univ. (France). Faculte des Sciences). 1970. 148p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis.

A summary dealing with ionizing-particle detection in plastics and with the different mechanisms proposed to explain the track formation in those detectors is given. The most salient features of the most sensitive detecting material (cellulose nitrate) are given. After describing the apparatus and technical methods, the results of many counting experiments of alpha particle tracks recorded by the detector are discussed. An easy statistical method is proposed. Finally, this new kind of alpha particle detection is applied to calculate the activity of radon by counting the tracks due to alpha particles emitted by RaC^1. (85 references.) (auth) (France)

50550 (NP–18440) INDIUM SANDWICH MEASUREMENTS WITH THICK PROBES AND NEW COUNTING AND EVALUATION METHODS. Burkart, Klaus (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Feb 1970. 100p. (In German). (INR–4/70–26). Dep. CFSTI (U. S. Sales Only).

Indium foil sandwich measurements employing beta, gamma, and coincidence counting are described, especially with regard to some aspects of the new beta technique. 2 and 3 foil sandwiches with foils up to 1.1 g/cm^2 were irradiated in a 1/E-neutron spectrum. Activation rate calculations involving the energy dependence of the neutron cross sections, the Doppler broadening of the resonances, the φ_0-function, the influence of the cadmium covers of the sandwiches, the activation by first collision neutrons, and the contribution of all resolved and unresolved resonances yielded good results. Differences between earlier calculations and gamma measurements could be explained. The beta counting rate of thick foils turned out to be strongly affected by secondary electrons due to Compton and photo effect as well as by beta and electron self-absorption. Relatively simple calculations are possible. As to the coincidence technique, difficulties caused by the different coincidence probability of beta particles and secondary electrons, respectively, with gamma rays are discussed. (auth)

50551 (NYO–3246–TA–7) RESEARCH ON AVALANCHE TYPE SEMICONDUCTOR RADIATION DETECTORS. Semiannual Report, January–June 1970. Moldofsky, Philip J.; Hewka, Peter V. (General Electric Co., Philadelphia, Pa. Space Div.). Jul 1970. Contract AT(30-1)-3246. 89p. Dep. CFSTI.

Seven esophageal probes have been produced in a continuing feedback-development collaboration with Kenneth Swinth of Battelle Northwest Laboratories. Based on the first animal studies performed with the avalanche detector, several probes were fashioned to achieve a probe with a lower in vivo Minimum Detectable Amount (MDA) [illegible] previous detectors. The latest in this series exhibits an MD[illegible] 25 nCi of plutonium in the biological geometry presently assumed, i.e., plutonium filtered into the bronchial and metastinal lymph nodes. A charge-sensitive preamplifier has been integrated into the standard AEC-sponsored detection in-

strument, providing greater electronic sensitivity than was available previously, and allowing use of detectors with greater area and detector probes on long cables. Crystal growth experiments are continuing in collaboration with a major U. S. grower. The effects of boron contamination have been observed, resulting in the improvement of this grower's crystal. Several additional types of experimental crystal from this manufacturer have been analyzed. Crystals from other U. S. Growers have been studied, and a possible new source of high quality, relatively uniform material has been identified. Production line silicon from several overseas growers has been received and analyzed. Additional material is currently being evaluated. In general, crystals grown by U. S. manufacturers appear to be considerably more uniform than that produced in other countries. The major U. S. growers possess certain proprietary float-zone growth techniques which have not yet been developed by the foreign manufacturers. Nuclear medical collaborations that are making use of the low noise and high sensitivity of the avalanche detector in detection of small quantities of radioisotopes now include ^{32}P detection in malignant melanomas; ^{32}P in breast tumors; ^{32}P in eye tumors; ^{85}Kr detection in brain blood flow and intracranial pressure measurements; and low energy, low activity plutonium detection. (auth)

50552 (SAN-549-6) RESEARCH AND DEVELOPMENT ON SINGLE CRYSTAL HIGH RESISTIVITY CADMIUM TELLURIDE FOR USE AS A GAMMA-RAY SPECTROMETER. Annual Summary Report, January 1, 1969–December 31, 1969. Zanio, Kenneth R. (Hughes Research Lab., Malibu, Calif.). Aug 1970. Contract AT(04-3)-549. 53p. Dep. CFSTI.

Single crystals of semi-insulating CdTe have been grown from the melt and vapor for spectroscopy purposes. Melt-grown crystals have been found to resolve photoevents from monoenergetic gamma emitters having a 10% spread in photon energy. These photopeaks were obtained at reduced biases to provide electron transport at approximately 50% charge collection efficiency. Photopeaks obtained with this meltgrown material at higher biases gave poorer resolution due to fluctuations in hole drift lengths or inadequate magnitude of the hole drift lengths. Detectors made from vapor-grown crystals resolve alpha particles with 1.5% resolution (FWHM) at 95% charge collection efficiency for electrons. With vapor-grown crystals, photopeaks have been obtained due to both electron and hole transport at 80% total charge collection efficiency. (auth)

50553 (STI/DOC-10/120) MONITORING OF RADIOACTIVE CONTAMINATION ON SURFACES. Clayton, R. F. (International Atomic Energy Agency, Vienna (Austria)). 1970. 33p. IAEA $2.00.

General techniques for direct surface monitoring are discussed; and indirect methods of surface monitoring are considered including dry smears, wet smears, large area swabs, adhesive tape samples, smair sampling, sniffing techniques, examination of rinsing and washing solutions, tritium smears, and skin and wound monitoring. Supplementary specialized techniques are described including autoradiography, thermoluminescence dosimetry, radiation spectrometry, air monitoring, deposition trays, overshoe and cleaning material monitoring, personnel dosimetry, biological monitoring, and pinhole cameras. Selection criteria, calibration, and performance testing of instruments are discussed. (85 references) (W.H.K.)

50554 INDIUM ANTIMONIDE DIODE AS NUCLEAR-PARTICLE COUNTER. Roth, Siegmar (Siemens AG, Erlangen, Ger.). Z. Naturforsch.; 25a: 314(Feb 1970). (In German).

The preliminary results on the counting of nuclear particles with InSb diodes were reported. At 75°K the pulses of α beams and protons were studied. The effective pair production energy was determined to be 2.5 eV. (tr-auth)

50555 INFLUENCE OF THE pH SOLUTION OF URANYL NITRATE ON THE DISCRIMINATION OF PARTICLE TRACKS. Beniss, J.; Bartmanski, J. (Silesian Univ., Katowice, Poland). Acta Phys. Pol.; 36: 1119-20(Dec 1969).

The influence of the pH solution of uranyl nitrate on the discrimination of particle tracks and the background of γ rays was investigated. The discrimination between binary fission fragments and α particle tracks increases for lower pH solutions of uranyl nitrate and the background of γ rays decreases with the fall of the pH solution of uranyl nitrate. (auth)

50556 WHOLE-BODY COUNTER FOR PRECISION IN VIVO MEASUREMENT OF RADIO-IRON. Palmer, H. E. (Pacific-Northwest Lab., Richland, Wash.); Cook, J. D. Pailthorp, K. G.; Finch, C. A. Phys. Med. Biol.; 15: 457-65(Jul 1970).

The in vivo counting system described accurately measures the absolute level of total body ^{59}Fe, regardless of body size or isotope distribution. These results are accomplished by: counting only the Compton scatter radiation emitted from the body rather than the full energy unscattered photons; employing an optimum arrangement of multiple NaI crystal detectors; and surrounding the subject with tissue equivalent plastic pellets. This counting system provides an accurate and efficient means for studying iron absorption or loss in man. (auth) (UK)

50557 ASYMMETRY PARAMETER MEASUREMENTS BY A PRECISE TECHNIQUE. Baker, K. D.; Hamilton, W. D. (Univ. of Sussex, Brighton, Eng.). Nucl. Instrum. Methods; 86: 77-81 (1970).

Aspects of a multidetector system capable of measuring asymmetry parameters with an accuracy of a few parts in 10^3 are discussed. It is shown that by having common analogue and logic elements the overall stability may be greatly improved and any necessary corrections considerably simplified. In particular the correction for accidental coincidences is negligible in most cases and the system is not too sensitive to source position or detector configuration. (auth)

50558 FACTORS IN THE PRECISION OF SLOW NEUTRON CAPTURE CROSS SECTION MEASUREMENTS USING A SIMPLE MOXON–RAE DETECTOR. Malik, S. S.; Brunhart, G.; Shore, F. J.; Sailor, V. L. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-1)-3567. Nucl. Instrum. Methods; 86: 83-91 (1970).

The practicality of using relatively simple apparatus for precise measurements of slow neutron capture cross sections has been explored. The capture gamma-ray production rate was measured by means of a very simple detector of the type invented by Moxon and Rae which consisted of a thick graphite converter placed next to a thin plastic scintillator mounted on a two-inch photomultiplier tube. All cross sections were measured relative to Au. It was found that cross sections can be obtained to a precision in the range of 1-2% provided that proper attention is given to sample purity, geometry, and corrections for multiple scattering and self-absorption. A variety of elements were tested covering a cross section range from <0.2 to >150 barn. Results are given for the elements Ni, Cu, Zr, Nd, Tb and Er at neutron energies of 0.033, 0.075, 0.115 and 0.270 eV and for Al, Ag and Ta at 0.070, 0.115, 0.364 and 0.835 eV. The measured values are consistent with 1/v dependence of the capture cross section for those elements having no nearly resonances. (auth)

50559 CALCULATION OF THE DETECTION EFFICIENCY OF A 3 INCH DIA. × 3 INCH NaI(Tl) CRYSTAL FOR A THICK DISK SOURCE. Nakamura, T. (Kyoto Univ.). Nucl. Instrum. Methods; 86: 163-8(1970).

The detection efficiency for a thick disk source on the extended axis of a 3″ dia. × 3″ NaI(Tl) crystal was calculated, both with and without consideration of self-absorption and self-scattering by analytical and Monte Carlo methods. In this study indium, aluminium, magnesium and iron thick disks were treated which are commonly used as neutron activation detectors. It was shown that the detection efficiencies with and without self-absorption decrease with increasing the thickness of the disk source, but the detection efficiency with self-absorption and self-scattering does not always monotonically decrease, but in some cases it increases at first and then decreases with increasing thickness of the disk source. (auth)

50560 GENERAL EXPRESSION FOR THE IDENTIFICATION OF CHARGED PARTICLES. Harmanci, A. E. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Nucl. Instrum. Methods; 86: 109-15(1970). (In French).

By reconsidering the results of the theory of the passage of charged particles through the matter, a correction extending the validity of the range-energy relationship towards low energies has been found. With a similar purpose, a research has been carried out in order to improve theoretically the constancy of the identification function. (auth)

50561 CHARGE COLLECTION PROCESS IN SEMICONDUCTOR RADIATION DETECTORS. Vass, D. G. (Univ. of Edinburgh). Nucl. Instrum. Methods; 86: 5-11(1970).

The discrepancy between the results of the calculation of the current pulse shape from a semiconductor radiation detector employing Ramo's theorem and that based on the energy balance equation of the charge collection process is discussed. The conclusion is reached that the application of Ramo's theorem is not valid in this case. A more general approach taking account of the change of electrostatic energy in the detector which is neglected in the energy balance equation is suggested. (auth)

50562 ISOMETRIC REPRESENTATION OF TWO-DIMENSIONAL MATRICES. Choudry, A. (Univ. of Rhode Island, Kingston). Comput. Phys. Commun.; 1: 277-80(Apr 1970).

A FORTRAN IV program is described which plots the values of a two-dimensional distribution as a two-dimensional plot having a 45° perspective. Examples of its use include exhibiting the charge distribution on a plate, the neutron flux on the surface of a large detector, the neutron intensity distribution at various distances from a reflecting wall rectangular collimator, etc. The output consists of punched cards for an off-line Benson-Lehner Graph Plotter. Storage required is 13,224 8-bit words. Run time for a typical 50 × 50 matrix is about a minute on an IBM 360/50. (R.W.R.)

50563 EXPERIENCES OBTAINED IN THE COURSE OF PREPARATION OF SURFACE-BARRIER DETECTORS. Bacso, Jozsef. ATOMKI (At. Kut. Intez.) Kozlem.; 12: 5-10(Jun 1970). (In Hungarian).

Experiences obtained in the course of preparation of surface barrier detectors are discussed. Best energy resolution (fwhm) was 18 keV for 6 MeV α-particles and 6.4 keV for 625 keV conversion electrons. (auth)

50564 ENERGY LOSS DISTRIBUTION OF RECOIL PROTONS IN STILBENE SCINTILLATOR. Obgushi, Akira (Hitachi Ltd., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo); 7: 466-73(Sep 1970).

Formulas are derived for calculating the energy loss distribution of recoil protons in a cylindrical organic scintillator with a broad beam of fast neutrons in the energy range 1 to 15 MeV perpendicularly incident on its base. The assumptions are: (1) the scintillator is composed solely of hydrogen and carbon; (2) only elastic scattering from hydrogen and carbon is considered in relation to the interaction of fast neutrons with the scintillator; (3) single and double scattering alone are considered; (4) wall effect is neglected for recoil protons produced in the second collisions; and (5) the radius and the thickness of the scintillator are greater than the range of recoil protons of the highest energy. As an example, the calculated results are shown for stilbene crystals of 1″ dia. and ⅛″ to 1″ thick. In scintillators of thicknesses below ¼″, and for incident fast neutrons in the energy range from 3 to 15 MeV, the contribution of double scattering to the energy loss distribution of recoil protons is below about 10% of that of single scattering, while wall effect is quite significant, in particular, for incident neutrons of high energy. (auth)

50565 ANGULAR INFORMATION IN A GRIDDED CHAMBER AND ITS APPLICATION. Mizuho, Mitsuru (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo); 7: 476-8(Sep 1970).

The use of a gridded chamber for determining the energy of alpha particles is discussed. The rise time of the anode pulse is analyzed with a rise time to pulse-height converter. The rise time of the anode pulse is found to be a function of the range of the particle and the angle the particle track makes with the electric field. From this information the energy can be determined. Alpha energy spectra of uranium-232 are shown. (W.H.K.)

50566 PERFORMANCE OF AN IMPROVED AIR SAMPLER FOR COLLECTING AIRBORNE RADIOIODINE. Fukuda, Seiji (Japan Atomic Energy Research Inst., Ibaraki); Naritomi, Mitsuo. J. Nucl. Sci. Technol. (Tokyo); 7: 450-7(Sep 1970).

An airborne radioiodine sampler composed of cellulose asbestos filter paper (HV-70 or HE-40), charcoal-impregnated filter paper (CP-20B) and two charcoal cartridges (CHC-50) was devised with the aim of ensuring higher and more reproducible collection efficiencies under high humidity conditions encountered in routine air monitoring. This paper describes the results of tests conducted on this sampler to determine its performance in collecting airborne ^{131}I released from an iodine processing cell and discusses the factors affecting the collection efficiency. The results are summarized as follows: (1) The sampler is notably superior in performance to current forms consisting of single filter medium in that the collection efficiency is far less dependent on relative humidity. Its collection efficiency is maintained at more than 75% on the average during a long sampling period of 24 hr even under very high humidity conditions. (2) During a short sampling period of 30 min the collection efficiency exceeds 80% for the airborne iodine sampled at the exit of an air cleaning system containing charcoal filters, while the efficiency reaches almost 100% for the unfiltered iodine under conditions of relative humidity ranging from 40 to 60%. (3) The collection efficiency is not affected significantly by face velocity. (4) The desorption of iodine collected in the sampler depends sensitively on relative humidity. (auth)

50567 MEASUREMENT OF ACCELERATOR PRODUCED STRAY NEUTRON SPECTRA. Holeman, G. R. (Yale Univ., New Haven). Amer. J. Public Health; 60: 1824-34(Sep 1970).

The Bonner spectrometer method of neutron spectral analysis is discussed. The Bonner spectrometer consisted of ^{6}LiI (Eu) scintillation counters of which one is bare and the others covered with a 0.03-inch thick cadmium cap and polyethylene moderating spheres. Also, ^{6}LiF and ^{7}LiF thermoluminescent dosimeters are used in moderating spheres for discrimination against gamma radiation. A floor plan of an MP tandem accelerator installation is presented which illustrates the monitoring locations. The process of converting neutron spectra to absorbed dose and dose equivalent is discussed and results are presented. (W.H.K.)

50568 QUICK METHOD FOR REACTOR FLUX MAPPING. Wang, Y. S.; Young, C. M.; Ma, P. Y. (National Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 7: 12-18(Oct 1969).

A metal wire of uniform cross section, after being activated in the reactor core for several minutes, is removed and mounted on a specially designed revolving wheel which is completely shielded except a small opening leading to a scintillation detector. The output of the detector is sent to a multiscaler where the counts are registered in its memory storage. By using a photoelectronic control, the start and stop of the multiscaler are synchronized with the rotation of the revolving wheel so that the counts induced by the radiation from each small segment (about one-hundredth of the length of the wire) will be stored in its corresponding channel of the multiscaler. The counts stored in each channel will then be accumulated as the wheel keeps rotating. After counting for several minutes the stored counts are read out by an autoprinter. The result represents the distribution of the neutron flux in the reactor core where the metal wire has been activated. Results using a copper wire are presented. (auth)

50569 PRELIMINARY APPLICATION OF A MATRIX INVERSION METHOD FOR RADIONUCLIDE IMAGING. Cahill, Patrick (Polytechnic Inst. of Brooklyn); Blau, Lawrence M. J. Nucl. Med.; 11: 613-15(Oct 1970).

A matrix inversion method is described with which an observed incremental scan of radioisotope point sources can be successfully corrected for asymmetric distortions produced by using a multichannel focusing collimator. (W.H.K.)

50570 DIGITAL RATEMETER SYSTEM FOR RECTILINEAR SCANNING. Simmons, G. H.; Hunkar, D. E.; Kereiakes, J. G. (General Hospital, Cincinnati. Bureau of Radiological Health, Cincinnati). J. Nucl. Med.; 11: 610-12(Oct 1970).

The performance of a digital ratemeter for modulating the intensity of the light exposing the film for film contrast enhancement in a rectilinear scanner is described. The modulation transfer functions of an analog ratemeter and a digital ratemeter are compared. A block diagram of the system is given, and results are briefly discussed. (W.H.K.)

50571 TOMOGRAPHY WITH A GAMMA CAMERA. Freedman, Gerald S. (Yale Univ., New Haven). J. Nucl. Med.; 11: 602-4(Oct 1970).

A system for gamma camera longitudinal and transverse tomography is proposed which uses a standard gamma camera, a special collimator and a digital computer. The system will permit the reconstruction of images in a layer-by-layer tomographic manner and display the results on an oscilloscope. (auth)

50572 DEVELOPMENT OF A NEUTRON-GAMMA DISCRIMINATOR USING NE-213 LIQUID SCINTILLATOR. Tang, M. D.; Wang, Nature (National Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 7: 36-49(Oct 1969).

An instrument developed for discriminating between scintillation pulses induced in NE-213 liquid scintillator by neutrons and gamma rays is described. The method utilizes a delay line to differentiate the fast linear output from the photomultiplier tube, and determines by their pulse amplitude whether they are produced by neutrons or gammas. Detailed descriptions are given of the detector and discriminator circuits. The gamma ray rejection ratio obtained is about 1 : 0.000074. (auth)

50573 SEMICONDUCTOR RADIATION DETECTORS. Goulding, Fred S.; Stone, Yvonne (Univ. of California, Berkeley). Science; 170: 280-9(16 Oct 1970).

Basic principles and some uses of semiconductor detectors are discussed. Topics include radiation energy determination by ionization, charge-production process, detector materials, spectrometer systems, x-ray fluorescence analysis, measurement of

very short decay lifetimes, particle identification, mesonic x-rays, and activation analysis. (W.H.K.)

50574 NUCLEAR INSTRUMENTATION. pp 87-163 of Handbook of Radioactive Nuclides. /Wang, Yen (ed.). Cleveland; Chemical Rubber Company (1969).

Topics include radiation detectors and equipment, radioisotope counting and calibration, improvement of liquid scintillation counting efficiencies by optimization of scintillator composition, modulation transfer function for radioisotope imaging systems, personnel monitoring, whole-body counter systems, information storage and retrieval in radioisotope imaging systems, and radioisotope cameras. (W.H.K.)

50575 EVALUATION OF QUALITY OF THE IMAGE IN GAMMA-RAY RADIOGRAPHY BY THE OPTICAL TRANSFER FUNCTION. Nojiri, Toshiaki (Industrial Research Inst., Yokohama, Japan). Radioisotopes (Tokyo); 19: 399-405(Sep 1970).

Methods of evaluating images of gamma-ray radiography were investigated from the standpoint of the optical transfer function in a receiving system with different sources. The optical transfer function was expressed by the sum of two error functions having different dispersion factors. The evaluation methods from several categories in terms of optical transfer function, that is, the function's value at a fixed spatial frequency, the spatial frequency at a given attenuation value, area, moment and others are used respectively for the evaluation. Also the relationships between various sharpness indexes usually used and the optical transfer functions were studied. The resultant value obtained by each evaluation method varied with each source. The ratios of the values obtained with three sources, ^{192}Ir, ^{137}Cs and ^{60}Co, were 135 : 100 : 73. If an object is inserted in the system, these ratios will be changed. Problems concerning the grains of metallic silver from film emulsion and the optical transfer function of observation itself are not considered. (auth)

50576 CONTROLLED FLEXIBLE BETA-PROBE FOR CONTACT RADIOMETRY OF MALIGNANT NEOPLASMS OF THE LUNGS. Krishtafovich, A. A.; Butorin, E. P.; Tsarev, A. S. Med. Radiol.; 15: No. 6, 72-4(Jun 1970). (In Russian).

A controlled flexible beta-probe is proposed for contact radiometry of malignant neoplasms of the lungs. The design of the probe is such that it could be introduced into any regions of the bronchial tree —lobar, segmental and subsegmental bronchi. The possibility of instrumental contact with the pathological formation could be used for purposes of differential diagnosis of malignant and benign tumors of the lungs. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 50350, 52582, and 52606.

50577 (KFK-1123) INVESTIGATIONS ON THE CORRELATION METHOD IN TIME-OF-FLIGHT EXPERIMENTS. Reichardt, W.; Gompf, F.; Wilhelmi, G.; Beckurts, K. H.; Glaeser, W.; Ehret, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Apr 1970. 30p. (CONF-691220-1). Dep. CFSTI (U. S. Sales Only).

From Meeting on Instrumentation for Neutron Inelastic Scattering Research, Vienna, Austria.

The attempt to increase the time utilization of the reactor beam in time-of-flight experiments has resulted in the construction of pseudostatistical chopping devices in some laboratories. So far choppers with an average transmission of about one half have been used. In this paper the problem of choosing an optimal chopping mechanism is attacked by minimizing a suitably defined statistical error of the time-of-flight distribution. This condition leads to a whole class of choppers with different time utilization of the reactor beam. An extensive error analysis for these choppers is given. Frequently the analysis of scattering experiments requires integration over a certain part of the time-of-flight distribution. It is shown that the gaussian law of error propagation is not strictly valid when the spectrum is obtained by a correlation method. However, in most practical cases the deviations are small. Some consideration is given to the feasibility of a pseudostatistical double chopper for slow neutrons, which allows to use all energies in the incident beam and measure all scattered energies simultaneously. The statistical accuracy for such an experiment is discussed. Some experiments were simulated on a computer in order to back up the theoretical investigations. (auth)

50578 (LYCEN-7008) STUDY OF ACTIVE FILTERS IN NUCLEAR SPECTROMETRY. Pagnotte, Yves (Lyon Univ. (France). Institut de Physique Nucleaire, Lyon Univ. (France)). Mar 1970. 95p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The problem of filtering signals coming from particle detectors was solved as a measurement problem, thus as a statistical estimation of the terms. It was shown how the theory of estimation led to a generalization and synthesis of the solutions to the optimal filtering problem, and to research into finding interesting filter networks. An attempt was made to describe from calculation and experiment the transient properties of these resistance capacitance filters. (France)

50579 Ge(Li)-Ge(Li) SUM-PEAK (SUMMING COINCIDENCE) SPECTROMETER. Kantele, J.; Suominen, P. (Univ. of Jyvaeskylae, Finland). Nucl. Instrum. Methods; 86: 65-76(1970).

The sum-peak spectrometer (also called the integral-bias summing coincidence spectrometer) arrangement earlier developed with NaI(Tl) detectors is extended to Ge(Li) detectors. The integral-bias method in sorting sums of coincident pulse amplitudes is replaced by a set of pulse-height selection windows, which simply and more effectively aid in the analysis of sum-peak complexities associated with the symmetric linear summing procedure employed. A large part of the original information lost in summing of the pulse amplitudes can be retained by simultaneous sorting of the total spectrum into suitable subgroups. The arrangement represents in effect a real-time totalizing spectrometer having a limited memory capacity. A good running-time economy is achieved at the expense of advance and subsequent computer analysis. A high-efficiency geometry with virtually no crystal-to-crystal scattering is introduced. The performance of the new spectrometer system is demonstrated and discussed. (auth)

50580 FAST NEUTRON TIME-OF-FLIGHT SPECTROMETER. Mubarakmand, S.; Khan, N. A.; Maher, P. K. (Atomic Energy Centre, Lahore). Nucl. Instrum. Methods; 86: 149-55(1970).

A 14.7 MeV neutron generator has been pulsed and provided with focusing and neutron monitoring facilities so as to enable it to operate as a fast neutron time-of-flight spectrometer. Pulse shape discrimination technique has been used to suppress unwanted gamma ray background. (auth)

50581 APPARATUS TO RECORD TIME-DEPENDENT MOESSBAUER EFFECT SPECTRUM IN ^{119}Sn COMPOUNDS. Carmeliet, J.; Lejeune, S. (Univ. Libre, Brussels). Nucl. Instrum. Methods; 86: 93-7(1970).

An installation for simultaneous recording of four time-dependent Mössbauer effect spectra is described. (auth)

50582 DETERMINATION OF THE FOLDING FUNCTION FOR CALCULATING PULSE PILE-UP SPECTRA. Waibel, E. (Physikalisch-Technische Bundesanstalt, Brunswick). Nucl. Instrum. Methods; 86: 29-34(1970). (In German).

In the calculation of the partial spectrum caused by pile-up effects the influence of the pulse shape is considered by a convolution integral over the ideal analyser spectrum and a probability distribution representing the weight of the momentary pulse heights. The probability distribution can be determined experimentally. The good agreement of measured and computed pile-up spectra using the observed analyser spectra as a first approximation is shown for some practical cases of pulse shapes and rates. (auth)

50583 USE OF SINGLE PLANAR Ge(Li) DETECTORS AS GAMMA-RAY POLARIMETERS. Litherland, A. E.; Ewan, G. T.; Lam, S. T. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys.; 48: 2320-30(1 Oct 1970). (AECL-3710).

The polarization sensitivity of a single rectangular Ge(Li) detector 40 × 25 × 3.5 mm was studied as a function of energy using gamma rays of known linear polarization produced in (p,p′γ) reactions. The counting rates in the total absorption peaks were measured with the 40 × 25 mm face perpendicular and parallel to the plane defined by the ion beam and gamma-ray direction. The asymmetry ratio was measured using E2 gamma rays with known polarization. From these results the following values of Q for complete polarization were deduced for a series of energies: 0.847 MeV (16.4 ± 1.0)%, 1.368 MeV (13.1 ± 1.0)%, 1.779 MeV (12.4 ± 1.5)%, and 4.43 MeV (6.4 ± 1.0)%. These results were in quantitative agreement with calculations made using the Klein–Nishina formula. A large volume detector 60 × 35 × 6.5 mm was studied in a similar manner. The corresponding results for complete polarization are: 0.847 MeV (16.4 ± 1.0)%, 1.368 MeV (14.3 ± 2.0)%, 1.779 MeV (11.6 ± 1.2)%, and 4.43 MeV (5.8 ± 1.5)%. These values are slightly higher than those obtained in calculations. Tests were also made with a lead collimator 6.25 cm long with an aperture of 1 cm in front of the larger polarimeter. The results for complete polarization are: 1.779 MeV (14.0 ± 1.5)% and 4.43 MeV (9.0 ± 1.0)%. Some recent applications of high-resolution Ge(Li) linear polarimeters are briefly discussed. (auth) (Canada)

High Energy Physics Instrumentation

Refer also to abstracts 51906, 51928, 52282, 52295, 52308, 52314, 52315, 52318–52324, and 52328.

50584 (JINR–P13-5170) SPARK CHAMBER MAGNETIC SPECTROMETER FOR STUDYING THE RARE DECAYS AND INTERACTIONS OF PARTICLES. Korenchenko, S. M.; Morozov, A. G.; Nekrasov, K. G.; Rodnov, Yu. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1970. 16p. (In Russian). Dep. CFSTI (U. S. Sales Only).

A cylindrical spark chamber placed in the 9000 Oe magnetic field is described which has been designed for studying the rare decays and interactions of pions and muons. The chamber is 40 cm in diameter and 30 cm high. The total number of gaps is 18 and the size of each gap is 5 mm. The solid angle viewed by the chamber is about 6 steradian. The coordinates along the axis of the cylinder are measured with the help of a prismatic device which was not used for the spark chamber technique earlier. The chamber is filled with neon. To obtain the necessary purity of neon the continuous purification system was applied. The chamber operation is controlled by the TV system. The chamber is triggered by the hodoscope system consisting of 19 scintillation counters. Some of the scintillators are placed inside the chamber. Pulses from photomultipliers are displayed, in addition, on the 5-ray oscilloscope screen. The spectrometer permits the search for decays with the branching ratios of the order of 10^{-6} to 10^{-9}. (auth)

50585 (NP–18480) DESIGN OF THE OPTICS OF A SPARK CHAMBER EXPERIMENT. Note No. 268. Laakso, I. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 5 Jun 1970. 12p. Dep. NTIS (U. S. Sales Only).

The optical system for the spark chamber setup for the Λ^0 missing mass spectrometer is described. The system is composed of two beam defining spark chambers (thin gap, 1 cm gap) in front of a liquid hydrogen target, followed by a wide-gap chamber. The wide-gap chamber is intended to reveal the two prongs from the Λ^0 produced in the $\pi^- + p \rightarrow \Lambda^0 + K^0$ interaction. A stereoscopic optical system is described to project the particle tracks onto a single film. (W.D.K.)

50586 (TID–25473(Vol.2)) BUBBLE CHAMBERS. 1969 Summer Study. Roberts, Arthur (ed.) (National Accelerator Lab., Batavia, Ill.). 316p. Dep. CFSTI.

Separate abstracts were prepared for the 33 papers presented. (W.H.K.)

For abstracts of individual papers see: 50587–50613, 51906–51908, 51926, 52314, and 52315.

50587 (TID–25473(Vol.2), pp 1-3) STRONG-INTERACTION PHYSICS IN THE 25-FT BUBBLE CHAMBER. Kenney, V. P. (Notre Dame Univ., Ind.); Sard, R. (Illinois Univ., Urbana); Walker, W. D. (Wisconsin Univ., Madison).

The utilization of a large bubble chamber for strong-interaction physics is discussed. (auth)

50588 (TID–25473(Vol.2), pp 5-31) STRONG-INTERACTION PHYSICS IN THE 25-FT BUBBLE CHAMBER. Alston-Garnjost, M. (California Univ., Livermore. Lawrence Radiation Lab.); Ballam, J. (Stanford Linear Accelerator Center, Calif.); Baltay, C.; (and others) (Columbia Univ., New York).

Many considerations have led to the conclusion that a large bubble chamber would be a highly useful tool for the study of strong interactions at the 200-BeV accelerator at NAL. Independently of other considerations, such as neutrino physics, it is felt that a chamber of the order of 25 ft in size is warranted by the capabilities of such a large chamber for strong-interaction physics. These conclusions are supported in detail in a series of eight short discussions of particular strong-interaction experiments. (auth)

50589 (TID-25473(Vol. 2), pp 33-44) MASS RESOLUTION FOR THE REACTION $\pi^+ + p \rightarrow \pi^+ + \pi^+ + \pi^- + p$ IN A HYDROGEN BUBBLE CHAMBER. Miller, David H. (Purdue Univ., Lafayette, Ind.).

The mass resolution of the 3π system, in the limit $t = 0$, for the reaction $\pi + p \rightarrow 3\pi + p$, was studied using a modified version of FOWL which includes track errors. The best resolution in the 3π mass is obtained by measurements of the three outgoing pions. The resolution at 50 GeV/c using only the recoil proton is not better than 80 MeV/c^2. At 50 GeV/c and track lengths of at least 1 meter, resolutions of 10 MeV/c^2 and 20 MeV/c^2 can be obtained for 3π masses 1 GeV/c^2 and 3 GeV/c^2 respectively. Therefore, a chamber with length at least 80 in. can do 4c physics at these momenta. A larger chamber, e.g., 25 ft (or 12 ft) while giving similar resolution, has many advantages. These include the flexibility of targets and H_2–Ne mixtures to pick up electron pairs, longer track lengths and the ability to maintain good resolution to much higher momenta. It is important to provide measurements of the beam track angles external to the chamber. (auth)

50590 (TID-25473(Vol. 2), pp 45-67) ELECTRON MOMENTUM ERRORS, SINGLE π^0 PHYSICS, AND $2\pi^0$ PHYSICS IN HYDROGEN–NEON MIXTURES IN THE 25-FOOT BUBBLE CHAMBER. Murphy, C. T. (Carnegie-Mellon Univ., Pittsburgh, Pa.).

The probable error in the bubble-chamber measurement of the momentum of high-energy electrons in hydrogen-neon mixtures is re-evaluated in the light of recent advances in measurement techniques and with the assumption of a 500 μ setting error. The expected errors are rather larger than those derived by Kalmus. The average error in gamma momenta and in momenta of constrained π^0 decays is then derived. With the aid of a Monte Carlo program, ambiguities in sorting out the four gammas from the decay of two π^0's is studied. Explicit comparison is made with the metal plate system suggested by Eisenstein and Kernan. Hydrogen-neon mixtures appear to be superior in all cases. Physics with two π^0's seems very feasible up to $p_{2\pi} = 50$ GeV/c. (auth)

50591 (TID–25473(Vol.2), pp 69-81) FAKE-GRIND STUDIES OF 50-GeV 4-PRONG PION-INDUCED INTERACTIONS IN THE 25-FOOT BUBBLE CHAMBER. Eisenstein, B. (Illinois Univ., Urbana).

A set of experiments in the 25-foot bubble chamber was simulated and analyzed using FAKE and GRIND. The reactions generated were $\pi^- + p \rightarrow \pi^- + p + \pi^+ + \pi^- + X$ at 50 GeV/c, where X represents no missing neutral, a fast π^0, a slow π^0, or two fast π^0's. Setting errors of 150 μ and 500 μ were employed. Fits were attempted in each case to pion hypotheses with no neutral, a missing π^0, or a missing neutron. The 4c events were uniquely identifiable and were not faked by other events. The majority of the 1c events were identifiable on the basis of χ^2. Events with slow π^0's were, of course, the most likely to confuse the fitting program. A sample of 4c events in $K^+p\pi^+\pi^-$ was briefly studied. (auth)

50592 (TID–25473(Vol.2), pp 83-7) PHOTOPRODUCTION EXPERIMENTS IN THE 25-FOOT HYDROGEN BUBBLE CHAMBER. Ballam, J. (Stanford Linear Accelerator Center, Calif.); Baltay, C. (Columbia Univ., New York).

The possibility of an experiment in the twenty-five foot hydrogen bubble chamber with energies up to 125 GeV is explored. (auth)

50593 (TID–25473(Vol.2), pp 89-90) MUON PHYSICS IN THE 25-FOOT BUBBLE CHAMBER. Block, M. M. (Northwestern Univ., Evanston, Ill.); Wachsmuth, H. W. (Wisconsin Univ., Madison, European Organization for Nuclear Research, Geneva (Switzerland)).

It is proposed to study the inelastic interaction of high-energy polarized μ^+ mesons in the 25-foot hydrogen bubble chamber located in the "neutrino area." Using about 100 muons per pulse in the 100 to 200-GeV energy region, for a 10^6 photo experiment, the 25-foot chamber allows one to obtain about 6,000 events for a 2 μb cross section. Thus rare processes at the level of 10^{-2} μb become accessible. (auth)

50594 (TID–25473(Vol.2), pp 91-5) NEUTRINO EXPERIMENTS IN THE 25-FOOT BUBBLE CHAMBER. Roe, B. (Michigan Univ., Ann Arbor); Baltay, C. (Columbia Univ., New York); Block, M.; (and others) (Northwestern Univ., Evanston, Ill.).

Neutrino experiments that are considered using the 25-foot bubble chamber are listed. This chamber is a powerful and, for many experiments, a unique tool for neutrino studies when used as a double chamber. It is strongly recommended that the chamber be built without delay and, if possible, even made deeper than presently planned. It is further recommended that development of the double-chamber technique be continued vigorously. (auth)

50595 (TID–25473(Vol.2), pp 97-107) NEUTRINO EXPERIMENTS: TOTAL CROSS SECTION, INELASTIC CROSS SECTION, AND ADLER TEST. Roe, B. (Michigan Univ., Ann Arbor).

The possibilities are examined of measuring the neutrino-nucleon total cross section, the inelastic cross section $d^2\sigma/dq^2d\nu$ where q^2 = magnitude of the momentum transfer at the lepton vertex, $\nu = E_{neutrino} - E_{final\ lepton}$ and of performing the Adler test relating neutrino events with low q^2 to pion production data. It is concluded that the 25-ft bubble chamber is an excellent instrument to use for these measurements but must be used in a double chamber mode in order that gamma rays can be converted and the energy of individual neutrino events obtained. If this is done it would appear possible to obtain the total cross section out to the neighborhood of 100 GeV with perhaps 20% errors. This will allow one to set a "one way limit" on the mass of the intermediate boson of around 15 BeV. In the inelastic cross sections one can search to about $Q^2 = 15$ (BeV/c)^2

for $40 < E_{neutrino} < 60$ BeV, and in terms of $x = Q^2/2 M\nu$ one can search down to $x \sim 0.005$ with decent statistics. The Adler test can be performed with about 10% statistics. (auth)

50596 (TID-25473(Vol. 2), pp 109-11) NEUTRINO EXPERIMENTS IN BUBBLE CHAMBERS: VECTOR MESON PRODUCTION, $\Delta S = \Delta Q$ TEST AND $\Delta S = 2$ TEST USING AN INTERFERENCE TECHNIQUE; HEAVY MUON SEARCHES. Roe, B. (Michigan Univ., Ann Arbor).

Vector meson production by neutrinos is considered. The rates are large enough to be seen in the NAL 25-ft bubble chamber. Background will be a problem but can probably be separated out by selecting events with short proton recoils only and then selecting appropriate mass bands. New $\Delta S = \Delta Q$ and $\Delta S = 2$ tests are proposed using $\nu n \rightarrow \mu^- K^0 p$ and $\bar{\nu} p \rightarrow \mu^+ \Lambda^0 K^0$ and making use of the fact that in the presence of violations of the above rules the K^0 will be a mixture of K^0 and $\bar{K}^0$. Hence the ratio of K_1^0 to K_2^0 decays will not be 1. These tests depend linearly on the amplitude of the violation component and are intrinsically more sensitive then experiments looking at ratios of violating and conserving rates, since the latter depend quadratically on the rates. It is pointed out that if a Low-type heavy muon exists, with a standard weak-interaction coupling, searches can be made for it at NAL, sensitive up to 6 or 7 BeV. (auth)

50597 (TID-25473(Vol.2), pp 165-72) DIFFICULTIES WITH LARGE BUBBLE CHAMBERS. Walker, W. D. (Wisconsin Univ., Madison).

Various difficulties associated with large bubble chambers and in particular the 25-foot bubble chamber as proposed by the BNL group are considered. The classes of problems considered are: 1. Optical problems associated with the large depth of field. 2. Transient effects produced by the expansion systems. Effect of delay times (from the propagation of the expansion wave) in the expansion system. 3. Mechanical stability. The conclusions are: 1. The bubble size required for visibility will be large, about 1 mm. This in turn means the growth time will necessarily be large. 2. The transient effects are large and must be carefully considered. The focusing properties of a sphere are such that parts of the chamber may be grossly over expanded. This might be a disaster in that it would short-circuit the expansion system. 3. The delay times will probably produce large transient stresses in the chamber body. 4. The position errors used in the calculations of Trilling and Derrick are probably considerably too small. (auth)

50598 (TID-25473(Vol.2), pp 173-4) NOTE ON THE SPACING OF THE COILS OF THE 25-FT BUBBLE CHAMBER. Juhala, R. (National Accelerator Lab., Batavia, Ill.); Kenney, V. P. (Notre Dame Univ., Ind.); Sard, R. D. (Illinois Univ., Urbana).

We discuss a proposal made in the 1968 Summer Study that the coil spacing of the 25-ft bubble-chamber magnet be increased from 5 ft to about 14 ft. It is concluded that this change is not needed for neutrino physics with the chamber and might even make the neutron background worse. For other experiments, the advantages of having a 40-kG field are felt to outweigh the increased accessibility for wide-angle counters that would result from spreading the coils apart. (auth)

50599 (TID-25473(Vol.2), pp 175-80) CHOICE OF MAGNETIC FIELD FOR 25-FT CHAMBER. Ascoli, G. (Illinois Univ., Urbana).

We have examined in some detail the importance of a high (40 kG) field for the study of strong interactions in the 25-ft bubble chamber filled with H_2 or D_2. For this application a lower field (say 25 to 30 kG) appears to be completely adequate. We recommend that the choice between a high field and some other desirable parameter (larger volume, less cost?) be based on the requirements of the neutrino program and not on the requirements of the strong-interactions program. (auth)

50600 (TID-25473(Vol.2), pp 181-3) IMPORTANCE OF HIGH MAGNETIC FIELD FOR THE 25-FT BNL CHAMBER. Roe, B. (Michigan Univ., Ann Arbor); Stevenson, M. L. (California Univ., Livermore. Lawrence Radiation Lab.).

For neutrino events that convert all outgoing neutrals, the neutrino's momentum is simply the sum of all outgoing momenta minus the target mass. This illustrates why the curvature measurement plays a more important role than the angle measurement for neutrino physics. Other reasons for maintaining as high a magnetic field as possible are trapping of particles to aid in their identification, reducing γ-ray ambiguities, and the reduction of possible backgrounds produced when the secondary particles produce nuclear showers in the Ne-H_2 region. (auth)

50601 (TID-25473(Vol.2), pp 185-7) PROPOSAL TO INCREASE THE PRECISION OF THE 25-FOOT BUBBLE CHAMBER. Palmer, R. (Brookhaven National Lab., Upton, N. Y.).

In addition to the 3 main cameras, 2 fiducial volume cameras are proposed that would photograph a limited volume at higher magnification, higher resolution, and smaller bubble-growth time. (auth)

50602 (TID-25473(Vol.2), pp 189-95) COSMIC-RAY BACKGROUNDS IN NEUTRINO EXPERIMENTS. Sard, R. D. (Illinois Univ., Urbana).

Cosmic-ray backgrounds in neutrino experiments are considered. In spark-chamber and counter experiments the time resolution permits effective vetoing of cosmic-ray events. Cosmic-ray backgrounds are not negligible in the 25-ft bubble chamber because of its long sensitive time and large volume. The muon flux with an estimated 5-msec sensitive time should be about 17 per picture. These tracks will not interfere with scanning and will serve to check the chamber sensitivity and illumination. Cosmic-ray neutrons, however, will simulate many of the neutrino-induced reactions. Analysis of the elastic reactions $\bar{\nu} + p \rightarrow \mu^+ + n$ followed by $n + p \rightarrow n + p$ and $\nu + n \rightarrow \mu^- + p$ shows that kinematic fitting can eliminate the fake cosmic-ray events in these experiments, but the labor of the analysis would be greatly reduced and the cleanness of the data enhanced by shielding out cosmic-ray neutrons. This would also be advantageous for the study of inelastic neutrino reactions. It is concluded that a hadron shielding roof, while not absolutely necessary, is desirable. A roof of 6 ft of earth or 2 ft of iron is recommended. (auth)

50603 (TID-25473(Vol.2), pp 197-201) MUON BACKGROUND IN THE 25-FOOT CHAMBER. Jovanovic, D. D. (Argonne National Lab., Ill.).

The background of muons due to either cosmic rays or neutrino interactions in the material within or outside the 25-foot bubble chamber is examined in some detail. The number of muons from such sources is found to be somewhat smaller than that quoted in the report of J. Peoples. Some methods of eliminating that background are also suggested. (auth)

50604 (TID-25473(Vol.2), pp 203-6) CAMERA VIEW OF COSMIC RAYS IN THE 25-FOOT BUBBLE CHAMBER. Huson, R.; Kopp, J.; VanderBurg, V. (Brookhaven National Lab., Upton, N. Y.).

Pictures of cosmic-ray muons and strong-interaction events in the 25-foot bubble chamber are simulated. It is assumed that the cosmic-ray muon flux is cut in half by shielding (11 feet of density 3.6 g/cm^3 material). The problem of particles produced in the neutrino shield or coils for neutrino experiments is not considered. (auth)

50605 (TID-25473(Vol.2), pp 207-11) MUON DETECTORS AFTER THE 25-FOOT CHAMBER. Jovanovic, D. D. (Argonne National Lab., Ill.); Palmer, R. (Brookhaven National Lab., Upton, N. Y.); Roe, B. (Michigan Univ., Ann Arbor).

It is suggested that an additional 10 interaction lengths or so of shielding material be placed at the end of the proposed NAL 25-foot bubble chamber with a suitable detector to tag non-interacting particles. A system of lead absorbers and proportional wire detectors is described. (auth)

50606 (TID-25473(Vol. 2), pp 213-23) MEASUREMENT OF π^0 MOMENTUM WITH METAL PLATE ARRAYS IN THE 25-FT BUBBLE CHAMBER. Eisenstein, L. (Illinois Univ., Urbana); Kernan, A. (California Univ., Riverside).

Measurement of π^0 momentum with metal plate arrays in the 25-ft bubble chamber is considered. If both γ's from π^0 decay convert in the array, a momentum measurement on each pair in the first gap following conversion, combined with the measured photon angles, permits a one-constraint fit to $\pi^0 \rightarrow 2\gamma$. For π^0's in the momentum range 1 to 10 GeV/c, a 2-meter long array of 9 plates, each 0.22 radiation lengths thick, gives reasonable errors. The median errors in momentum and angle for a 5 GeV/c π^0 are $\Delta p_\pi/p_\pi = 7\%$ and $\Delta\xi_\pi = 0.2$ deg, assuming a setting error of 500 μ and 40 kG field. Several possible arrangements of the arrays in the chamber are considered. (auth)

50607 (TID-25473(Vol.2), pp 225-8) RECONSIDERATION OF A SPHERICAL 25-FOOT BUBBLE CHAMBER IN THE LIGHT OF TRACK-SENSITIVE TARGETS. Palmer, R.; Huson, R. (Brookhaven National Lab., Upton, N. Y.); Stevenson, M. L. (California Univ., Livermore. Lawrence Radiation Lab.); Baltay, C.; (and others) (Columbia Univ., New York).

Many advantages of a spherical design are presented. The size of track-sensitive target that can be used is increased from 10 k liters to 35 k liters. Engineering, optics, trapping, and ex-

perimental convenience are all improved. The increased cost is small and might be completely offset if it proves feasible to operate with deuterium inside the target and neon-hydrogen outside. (auth)

50608 (TID-25473(Vol.2), pp 229-37) TRACK SENSITIVE TARGETS IN THE 25-FOOT BUBBLE CHAMBER. Huson, R. (Brookhaven National Lab., Upton, N. Y.).

From tests at DESY, BNL, and Rutherford, it is evident that track-sensitive targets (TST) in bubble chambers will work. It appears quite feasible to operate TST's filled with H_2 or D_2 and surrounded by 0 to 100% hydrogen-neon mixtures. This report gives some of the technical details of a TST for the 25-foot, detection efficiencies for γ's, π^0's, K^0_1, and n with this TST, and measurement errors on e^+ and γ. (auth)

50609 (TID-25473(Vol.2), pp 239-48) CONSIDERATIONS ON THE USE OF NEON-HYDROGEN DOUBLE CHAMBERS. Roe, B. (Michigan Univ., Ann Arbor).

This report is intended as an introduction to the advantages and limitations of the double chamber technique (track-sensitive targets) in the proposed NAL 25-foot bubble chamber. It is argued that the technique will be useful for both strong and weak interaction studies. (auth)

50610 (TID-25473(Vol.2), pp 249-54) NEON-HYDROGEN MIXTURES AND TRACK-SENSITIVE TARGETS FOR BUBBLE-CHAMBER EXPERIMENTS AT NAL. Kenney, V. P. (Notre Dame Univ., Ind.).

The state-of-the-art of neon-hydrogen mixtures and track-sensitive targets for bubble-chamber experiments is reviewed and their usefulness for NAL experiments is discussed. (auth)

50611 (TID-25473(Vol.2), pp 255-69) TWENTY-FIVE FOOT BUBBLE CHAMBER FILM FORMAT AND FILM ANALYSIS COSTS. Alston-Garnjost, Margaret; Stevenson, M. L. (California Univ., Livermore. Lawrence Radiation Lab.); Gelfand, N. (Chicago Univ., Ill.); Lach, J.; (and others) (National Accelerator Lab., Batavia, Ill.).

Recommendations are made that the 25-ft bubble-chamber film format be as consistent as possible with that of other large chambers. Some assumptions are made about scanning and measuring methods and speeds. The cost (capital investment in machinery, computer costs, and salaries) is then estimated. (auth)

50612 (TID-25473(Vol.2), pp 271-6) SLIGHTLY MORE MODERN BUBBLE CHAMBERS. Walker, W. D. (Wisconsin Univ., Madison).

A review of the state of the art of rapid-cycling bubble chambers is given. A chamber is proposed for NAL (1.5 meters × 0.5 × 0.5 meters^2 with 40 to 50 kG and 30 to 50 cps). A proposal for the use of such a chamber would indicate the possibility of doing 100 events/μb experiments with reasonable effort. (auth)

50613 (TID-25473(Vol.2), pp 277-8) REMARKS ON THE USE OF BUBBLE CHAMBERS FOR STRONG-INTERACTION PHYSICS. Kirz, J. (State Univ. of New York, Stony Brook).

Some general arguments are presented on the role of bubble chambers for strong-interaction studies at NAL. (auth)

50614 (TID-25473(Vol.3)) ELECTRONIC DETECTORS, 1969 Summer Study. Roberts, Arthur (ed.) (National Accelerator Lab., Batavia, Ill.). 343p. Dep. CFSTI.

Separate abstracts were prepared for the 28 papers presented. (W.H.K.)

For abstracts of individual papers see: 50615-50628, 51927, and 52316-52328.

50615 (TID-25473(Vol.3), pp 7-10) COUNTER HODOSCOPES USING CODED ELEMENTS. White, T. O. (National Accelerator Lab., Batavia, Ill.).

General design and application considerations are discussed for scintillation counter hodoscopes which employ efficiently coded elements at the NAL Synchrotron. (auth)

50616 (TID-25473(Vol.3), pp 11-15) DIFFERENTIAL CHERENKOV COUNTERS IN HIGH QUALITY BEAMS. White, D. H. (Cornell Univ., Ithaca, N. Y.).

The criteria for designing differential Čerenkov counters at high momenta for secondary beams at the NAL Synchrotron are discussed. (auth)

50617 (TID-25473(Vol.3), pp 17-34) NOTES ON SOME EXPERIMENTAL TECHNIQUES FOR 200-GeV PHYSICS: WIDE-GAP SPARK CHAMBERS AND GAS PROPORTIONAL COUNTERS. Jones, Lawrence W. (Michigan Univ., Ann Arbor).

The utility of wide-gap spark chambers at NAL is discussed on the basis of experience with this technique in current cosmic-ray experiments. The potentiality of spatial resolution superior to that obtainable with other spark-chamber systems is emphasized. Secondly, the utility of a system of gas proportional counters for particle identification through the relativistic rise is explored, and the results of an earlier study are discussed. (auth)

50618 (TID-25473(Vol.3), pp 35-48) MEASUREMENT OF PARTICLE VELOCITIES AT NAL. Dorfan, D. (California Univ., Santa Cruz.).

A survey of various possibilities for counters to determine the velocities of particles in the NAL energy range is given. Čerenkov, dE/dx, secondary emission, transition radiation, and miscellaneous other counters are considered. It is concluded that only Čerenkov counters provide proven capabilities at present, with transition radiation and secondary-emission detectors showing promise for the future. (auth)

50619 (TID-25473(Vol.3), pp 49-50) TESTS ON TOTAL ABSORPTION DETECTORS AT NAL. Hofstadter, Robert (Stanford Univ., Calif.).

A brief qualitative discussion is presented indicating why it appears useful to perform tests at NAL on total absorption detectors. The possibility of detecting neutral radiations is emphasized. (auth)

50620 (TID-25473(Vol.3), pp 51-6) NOTE ON TOTAL ABSORPTION DETECTORS IN THE 100-GeV ENERGY RANGE. Heusch, C. A. (California Inst. of Tech., Pasadena).

A brief review is given of the basic features of total energy detection for hadronic and electromagnetic cascades. It appears that statistical fluctuations, which limit the resolution of many cascade detectors at low energies, will allow simple discretely sampling detection devices to be quite competitive at NAL energies. In particular, counters sensitive mainly to the electron-positron component (i.e., to the highest velocity particles) will benefit from the fraction of the total cascade energy contained in the electromagnetic part, which increases with energy. Simple and inexpensive sandwich counters may well be very appropriate detectors for many applications. Early tests of these phenomena are urged. (auth)

50621 (TID-25473(Vol.3), pp 57-63) NEUTRAL HADRON DETECTORS FOR NAL. Jones, Lawrence W. (Michigan Univ., Ann Arbor).

Total absorption detectors for neutrons and neutral kaons are discussed in the context of 200-GeV experiments. The state-of-the-art of ionization calorimeters (iron-scintillator sandwich arrays) is reviewed and compared with Hofstadter's TANC (sodium iodide crystal) detector. (auth)

50622 (TID-25473(Vol.3), pp 65-73) SUGGESTED DEVICE FOR PRECISE MEASUREMENT OF PARTICLE TRAJECTORIES. Hofstadter, Robert (Stanford Univ., Calif.).

A suggested device for particle detection and measurement is described in which the intersection of a high-energy particle's trajectory with a detecting plane may be measured with a potential precision of 0.01 mm or better. The detecting plane consists of a thin inert material coated with a thin layer of scintillation material. (auth)

50623 (TID-25473(Vol.3), pp 75-8) POSITION-INDICATING PROPORTIONAL COUNTER. Wilson, R. R. (National Accelerator Lab., Batavia, Ill.).

A type of detector is proposed in which a very fine mesh wire array (20 wires per mm) is used as a proportional counter plane. The wires are led into the interior of a vacuum tube, and the identification of which wires have counted is obtained by using the charge provided by the proportional counter pulse to deflect either a scanning beam, provided by an auxiliary electron gun, or a slow secondary electron beam produced by the scanning beam. (auth)

50624 (TID-25473(Vol.3), pp 79-102) PROSPECT OF HIGH-SPATIAL RESOLUTION FOR COUNTER EXPERIMENTS AT NAL: A NEW PARTICLE DETECTOR USING ELECTRON MULTIPLICATION IN LIQUID ARGON. Derenzo, Stephen E.; Muller, Richard A.; Smits, Robert G.; Alvarez, Luis W. (California Univ., Livermore. Lawrence Radiation Lab.).

We have observed the multiplication of ionization electrons in liquid argon near the surface of a fine wire electrode. This effect shows promise of being used in a detector having high spatial resolution, since the density of liquid argon permits a thin gap and close wire spacing, and the pulse is large enough to permit convenient readout. (auth)

50625 (TID-25473(Vol.3), pp 103-16) POSITION AND TRACK MEASUREMENT. Neal, H. (Indiana Univ., Bloomington); Pipkin, F. M. (Harvard Univ., Cambridge, Mass.).

This paper gives a summary of six seminars held concerning the measurement of particle trajectories during the first month of the 1969 NAL Summer Study. It also summarizes the authors' recommendations for the role of NAL in the future development of these techniques. (auth)

50626 (TID-25473(Vol.3), pp 117-22) WIRE ARRAYS VS VIDICONS: A COMPARISON OF LARGE WIRE ARRAYS WITH OPTICAL SPARK CHAMBERS USING VIDICON READOUT. Roberts, A. (National Accelerator Lab., Batavia, Ill.).

Digitized spark-chamber systems using wire arrays are being used for increasingly complex types of events; their chief virtue is the provision of "on-line" information on the progress of the experiment, which we interpret as rapid enough to allow the results obtained to influence the future course of the experiment. Such on-line operation can also be obtained by several other methods for digitizing the data and introducing it into a computer. In particular, comparisons are made of the properties of wire arrays with a digitizing system in which visual spark chambers are viewed by vidicon television pickup tubes, whose output is immediately digitized for either tape storage or input to a computer. Such TV pickup systems have greater flexibility, require fewer special data storage provisions, automatically provide for indefinitely large numbers of tracks and track samplings and data redundancy, and fewer modifications for different experiments than wire arrays. In view of expected cost variations with size, it is likely that for sufficiently large systems, wire array readout will cost more than vidicon readout, in addition to being less flexible. Vidicon digitization is clearly preferable when many samplings are required, as in gamma-ray shower-detecting chambers. (auth)

50627 (TID-25473(Vol.3), pp 123-7) DIGITIZING DEVICE FOR FILMLESS VISUAL DETECTORS. Villa, F. (Stanford Linear Accelerator Center, Calif.).

A device for eliminating film as data storage for visual detectors is described. The device is particularly suited for streamer chambers. (auth)

50628 (TID-25473(Vol.3), pp 129-39) WHAT IS NEW IN STREAMER CHAMBERS. Villa, F. (Stanford Linear Accelerator Center, Calif.).

A brief summary of significant developments in streamer-chamber technology at SLAC and elsewhere is presented. (auth)

50629 TRAPPING AND TAILING EFFECTS IN Ge(Li) DETECTORS. Armantrout, Guy Alan. Lafayette, Ind.; Purdue Univ. (1969). 217p. University Microfilm Order No. 70-8849. Thesis.

Ge(Li) detectors, which are very high resolution gamma-ray spectrometers, are very sensitive to any crystal impurities or defects which result in charge carrier trapping in the detector. The detector performance degradation results from the statistical variation in the quantity of charge produced and from inhomogeneities in the original material. A more exact model was needed to fully describe the performance degradation and a study was needed to determine the important trap carrier capture parameters. Measurements were developed or adapted to study specific aspects of the detector performance and to measure the pertinent trap parameters. These measurements include: infrared absorption of the initial germanium, response of the detector to monochromatic infrared light, infrared transmission television, detector reverse current versus temperature measurements, photoconductive decay time, electrolytic etching and copper staining decoration of the crystal, and direct detector performance evaluation. (TSS) (Diss. Abstr. Int., B)

50630 LOGIC CONTROL OF A STREAMER CHAMBER EXPERIMENTAL SET-UP. Roche, G.; Fargeix, J.; Girard, G.; Ramos, F. (Univ., Clermont-Ferrand, France). Nucl. Instrum. Methods; 86: 61-4(1970).

The logic control unit of a streamer chamber experimental set-up is described. This logic unit was built with integrated circuits, and is very simple and cheap. Its performances and possibilities are given. (auth)

50631 HIGH RESOLUTION PION AND PROTON SPECTROSCOPY AT LAMPF. Thiessen, Henry A. (Los Alamos Scientific Lab., N. Mex.). pp 595-602 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The development of a high resolution proton beam and spectrometer for the investigation of proton induced reactions and, also, a beam channel and spectrometer for relatively energetic pions at the Los Alamos Meson Physics Facility is described. The proton spectrometer is designed to use any one of three detectors including wire spark chambers, Charpak proportional counters, and filament scintillation hodoscopes. (W.H.K.)

50632 CERN SPARK CHAMBERS. Krienen, Frank (European Organization for Nuclear Research, Geneva). Ind. At.; 14: 23-32(1970). (In French).

The spark chambers used at CERN are valuable instruments for the analysis of nuclear interactions. In a number of cases, they have enabled new particles to be discovered. Their variety makes them very adaptable to the diverse conditions of experimentation. They can, for example, be massive, or can give rise to only insignificant multiple scattering. They can cover large solid angles, or then can explore small angles with long levers and great precision. They can be adapted to dense particle flows and to high recording frequencies. They can be directly connected to an on-line computer, giving the results rapidly to the experimenter. (auth) (France)

50633 DEVELOPMENT OF THE SUPERCONDUCTING MAGNET OF THE EUROPEAN BUBBLE CHAMBER. Wittgenstein, Francois (European Organization for Nuclear Research, Geneva). Ind. At.; 14: 33-46(1970). (In French).

A big hydrogen bubble chamber is now being constructed at CERN. The superconducting magnet, 4.7 m in diameter, and the 3.5 Tesla magnetic induction surrounding the bubble chamber which is to be put into service in 1972 is described. The general principles involved in the calculations of the characteristics of very large diameter magnets are enumerated; the essential features of type 2 semiconductors are discussed. Details of the magnet, i.e. coils, components, winding operations, stainless steel vessels and magnetic shielding are given. (auth) (France)

Radiation Dosimeters

Refer also to abstract 51776.

50634 (CEA-R-4049) DEVICE FOR THE IONOMETRIC DETERMINATION OF THE DOSE ABSORBED IN VARIOUS MATERIALS. STUDY OF THE AIR AND TISSUE EQUIVALENCE OF VARIOUS MATERIALS USED IN PHOTON DOSIMETRY. Troesch, Gilbert (Commissariat a l'Energie Atmiquie, Saclay (France). Centre d'Etudes Nucleaires). Aug 1970. 99p. (In French). Dep. CFSTI (U. S. Sales Only).

A device for the ionometric measurement of the dose absorbed in different materials was used. The effect of the nature of the walls on the volume ionization current collected in an ionization chamber by a photon flux was examined. Also, a theoretical and practical examination of the equivalence of materials is described. A direct application was the experimental verification of the air equivalence of a Teflon-carbon mixture, and the tissue equivalence of a mixture of polyethylene and magnesium fluoride for photons with an energy between 0.0595 and 1.25 MeV. (auth)

50635 (RD/B/N-1677) NFLO: A FORTRAN IV SUBROUTINE FOR ANALYSING THERMOLUMINESCENT DETECTOR DATA. Longworth, J. P. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Jul 1970. 20p. Dep. NTIS (U. S. Sales Only).

NFLO calculates integrated gamma dose equivalent and thermal neutron fluence from data given by thermoluminescent detectors. The TL readings are corrected for instrument noise and sample weight variation. The exposure dose is calculated using calibration factors which may be either given or calculated by the program from other TLD readings. The thermal neutron fluence is found by correcting for gamma sensitivity and applying a further calibration factor. NFLO is one of two subroutines used in SUMI, a code for analysing DELTA spectrometer data, but may also be used on its own. (auth) (UK)

50636 DOSIMETRY OF ^{210}Po ALPHA PARTICLES. Scarpa, Giorgio (CNEN, Rome). G. Fis. Sanit. Prot. Radiaz.; 13: 109-20(1969). (In Italian). (RT/PROT-(69)45).

The results are given of experimental and theoretical studies on the evaluation methods of particle fluence and dose absorbed by a biological sample irradiated with a ^{210}Po disk-shaped alpha source. Calculations and measurements with a surface barrier detector and with an ionization extrapolation chamber are described. The method that, on the whole, appeared as the most convenient in practical applications was the one making use of an ionization extrapolation chamber. Results are also reported

of a study on the distribution of fluence and dose on the surface and inside the sample. Some objective criteria for selecting the technical parameters of irradiation are discussed. (auth)

50637 EFFECT OF QUENCHING TEMPERATURE AND RATE ON THERMOLUMINESCENCE IN HIGH PURITY LITHIUM FLUORIDE. Guilmel, G. M.; Stoebe, T. G.; Dawson, H. I. (Univ. of Washington, Seattle). Health Phys.; 19: 582-4(Oct 1970).

The dependence of the thermoluminescence properties of pure LiF crystals on heat treatment was investigated and is reported in an attempt to explain the effects for use in dosimetry. However further work is necessary before the experimental results can be understood. (UK)

50638 THERMALLY STIMULATED EXOELECTRON EMISSION, THERMOLUMINESCENCE, AND IMPURITIES IN LiF AND BeO. Becker, Klaus; Cheka, J. S.; Oberhofer, M. (Oak Ridge National Lab., Tenn.). Health Phys.; 19: 391-403(Sep 1970).

In order to obtain more information on the relation between thermally stimulated exoelectron emission (TSEE), thermoluminescence (TL), and the impurity content in different TL grade, analytical and technical grade samples of LiF and BeO, a number of experiments were carried out, in particular (a) semiquantitative spectroanalysis and mass spectrography, (b) an investigation of the TL sensitivities and glow curves for different dose levels and LET of the radiation, and (c) studies on TSEE sensitivity and peak locations (including their dependence on LET and heating rate). Sintered BeO samples exhibit the highest TSEE sensitivity, in particular after their work function has been reduced by the partial diffusion of inert metals into the surface. The results are discussed on the basis of the existing information on TSEE and TL in LiF and BeO. (auth) (UK)

50639 USE OF Al_2O_3-MONOCRYSTALS FOR NON-NUCLEAR NEUTRON FLUENCE MEASUREMENTS. Jeltsch, E. (Kernforschungsanlage, Juelich, Ger.). Atomkernenergie; 15: 312(1970). (In German).

Neutron fluxes from 10^{17} to 10^{20} n/cm^2 were measured with Al_2O_3 monocrystals and evaluated with a spectrophotometer. At lower fluxes, shorter wavelengths between 200 and 300 mμ were preferable because of higher sensitivity. At higher fluxes, wavelengths up to 550 mμ had to be used because of discoloration of the crystal. Shielding experiments showed that thermal neutrons did not affect the results. Experimental data were presented in one diagram. (H.B.G.)

Radiometric Instruments

Refer also to abstracts 50508 and 50534.

50640 DETERMINATION OF THE CORROSION POINTS IN THE BOILER PIPES BY MEANS OF ^{170}Tm ISOTOPES. Lebron, J. C. (Univ. Nacional, Asuncion). Rev. Soc. Cient. Paraguay; 8: 20-4(1967). (In Spanish).

The radioisotope ^{170}Tm, coupled to a suitable setup, was used for the detection of corrosion centers in the pipes of a boiler from the ANDE (Administración Nacional de Electricidad). The method proved to be simpler, more accurate, and faster than the classical procedures. (auth)

Miscellaneous Instruments and Components

Refer also to abstracts 50350, 51620, 51785, 52743, 52747, 52861, 52873, 52874, and 52930.

50641 (AI-AEC-12941) TRANSIT TIME FLOWMETER EMPLOYING NOISE-ANALYSIS TECHNIQUES. PART 2. 2-IN. SODIUM-LOOP TESTS. Randall, R. L. (Atomics International, Canoga Park, Calif.). 30 Sep 1970. Contract AT(04-3)-701. 99p. Dep. NTIS.

This report describes Part 2 of a program to develop a Transit Time Flowmeter using noise-analysis techniques. Part 2 of the program consists of development and demonstration tests of a 2-in.-diam Transit Time Flowmeter in 80°F water at flow-rates to 15 ft/sec and in sodium at operating temperatures up to 1200°F and flowrates to 10 ft/sec. The previously completed Part 1 of the program included the development of the first model of the Transit Time Flowmeter and related components, and the first tests of this concept using 1½- and 2-in.-diam flow sections with water as the working fluid. The Transit Time Flowmeter uses sheathed thermocouples with matched-time response installed on replaceable fin-like sensors at two axial positions in a flow channel to detect in the moving fluid random-temperature fluctuations in the range of 0.01 to 1.0°F peak-to-peak. A Transit Time Computer instrument system has been developed to provide a continuous readout of the time for fluid transport between sensors. The Transit Time Flowmeter has applications in accurate measurements of flowrate (velocity) in large sodium loops as a flow-calibration technique and in measurements of flow from individual fuel-element assemblies in sodium-cooled and other types of reactors. (auth)

50642 (BNL-14508) ELECTROCHEMICAL CARBON METER FOR USE IN SODIUM. Salzano, F. J.; Newman, L.; Hobdell, M. R. (Brookhaven National Lab., Upton, N. Y.). [1970]. 43p. Dep. NTIS.

The feasibility of an electrochemical carbon meter which measures the chemical activity of carbon in sodium at temperatures from 600° to 700°C has been demonstrated. The cell has a Na_2CO_3–Li_2CO_3 electrolyte and has been shown to respond to the addition of various carbonaceous reagents which were added to the sodium, especially carburized iron. Some tests of a cell with a CaC_2–LiCl electrolyte are also reported. The chemical activity of carbon in equilibrium with a 347 SS-sodium system has been measured. The use of the meter to indicate when carburizing or decarburizing conditions exist in the sodium is discussed. Some data on the solubility of carbon in sodium determined with the carbon meter are reported. The meter can be used to measure the concentration of carbon in sodium by making use of solubility data. (auth)

50643 (IS-Trans-82) ELECTRIC COLLECTION TRIALS WITH THE MS-702. Blanchard, B. ([Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires]). Translated for Ames Lab., Iowa, from a French report. 13p. Dep. NTIS.

An electrical detection system which may be adapted to the characteristics of a spark source mass spectrometer is briefly described. (W.H.K.)

50644 (NP-18412) DEVELOPMENT OF AN AUTOMATIC PORTABLE AITKEN NUCLEUS COUNTER. Cabrol, Christian (Toulouse Univ. (France). Faculte des Sciences). 1970. 84p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis.

After reviewing the general theory of the heterogeneous condensation, the realization of an automatic portable Aitken nucleus counter is presented. This counter has a big interest for the investigations "in situ." Theoretical and experimental calibrations are in good agreement. A large number of experiments were carried out under both free and confined atmospheres. The daily profile in the atmosphere is different with the season. Results obtained in a uranium mine showed the importance of this parameter in radioprotection. (France)

50645 (NYO-3882-2) MEASUREMENT OF SULFUR DIOXIDE IN STACK GASES. DEMONSTRATION INSTRUMENT: DESIGN, FABRICATION, AND TEST. Pfeifer, Robert J. (Industrial Nucleonics Corp., Columbus, Ohio). 28 May 1970. Contract AT(30-1)-3882. 103p. Dep. NTIS.

The technical and economic feasibility of measuring the sulfur dioxide content of stack gases continuously by means of a mercury substitution-nucleonic detection technique has been established as a result of extensive laboratory and field testing of a working model instrument. This instrument provides a measurement of sulfur dioxide from 100 to 4000 ppm within an accuracy of 10% and a response time of about 15 minutes. The major advantages of the instrument are simplicity of sampling (no sample conditioning is required) and ease of maintenance (maintenance functions are required less frequently than once a week). Based on the results of the feasibility tests, a continuing program has been established to improve various chemical engineering features of the instrument. (auth)

50646 (PURC-4159-1) APPLICATIONS OF CERTAIN HIGH ENERGY PHYSICS TECHNIQUES TO SOME PROBLEMS IN BIOLOGY. Technical Report No. 1. Reynolds, Geo. T. (Princeton Univ., N. J. Elementary Particles Lab.). 4 Jul 1970. Contract AT(30-1)-4159. 58p. Dep. CFSTI.

The development of image intensifiers in high energy physics is briefly discussed, and the applications of image intensifiers in biological research are discussed. Topics include bioluminescence, image intensification of a luminescent system as a cytochemical probe, radioactive tracer detection, quantum efficiency of the human eye, and x-ray image intensification. (W.D.K.)

50647 (SJC-A-70-5) MODIFIED PEAKING STRIP METHOD FOR MEASUREMENTS OF SLOWLY VARYING LOW FIELD. Endo, Kuninori; Sasaki, Hiroshi (Tokyo Univ. (Japan). Inst. for Nuclear Study). Jul 1970. 17p. Dep. CFSTI (U. S. Sales Only).

A modified peaking strip method for the measurement of the dynamic low field has been developed. By superposing the high frequency field to the peaking strip, the pickup voltage becomes large and signal-to-noise ratio is improved remarkably. The apparatus was developed to measure the injection field of the proton synchrotron model magnet under dynamic excitation. (auth)

50648 SCALE-OF-2 INPUT CIRCUIT TO A SATURATING DIODE-PUMP RATEMETER. Vincent, C. H.; Parker, J. B. (United Kingdom Atomic Energy Authority, Aldermaston, Eng.). Nucl. Instrum. Methods; 86: 169-70(1970).

A previous paper gave the exact output voltage distribution for a saturating diode-pump ratemeter with randomly timed input pulses. The appendix to that paper showed how to calculate this distribution to a close approximation for the case of scale-of-2 input by finding an equivalent direct-input diode-pump circuit, which is valid provided that each driving waveform is short in duration compared with the intervals between the pulses. The present letter describes a modification of this equivalent circuit which is necessary when the duration of the driving waveform extends from one input pulse to the next one, as is the normal case with scale-of-2 input. (auth)

50649 FABRICATION OF SEMICONDUCTOR DEVICES AND SILICON MICROCIRCUITS BY NEUTRON-TRANSMUTATION DOPING. Isotop. Radiat. Technol.; 8: 37-60(Fall 1970).

The fabrication of semiconductor devices and silicon microcircuits by neutron-transmutation doping is summarized. Methods and device characteristics are discussed for rectifying diodes, transistors, voltage-variable capacitors, and resistors. Performance, cost, and controllability of transmutation doping for microcircuit fabrication are described. Also, new methods for the extension of neutron-transmutation doping to the fabrication of complex microcircuits in silicon are discussed. (W.H.K.)

50650 DETECTION OF ART FORGERIES BY X-RAY-FLUORESCENCE SPECTROSCOPY. Frankel, Richard (Kevex Corp., Burlingame, Calif.). Isotop. Radiat. Technol.; 8: 65-9(Fall 1970).

An x-ray-fluorescence spectrometer that contains a multichannel analyzer, and thus can determine several elements simultaneously, is described, together with applications of the instrument to the detection of art forgeries. (auth)

50651 FRENCH X-RAY-FLUORESCENCE ANALYZER. Isotop. Radiat. Technol.; 8: 122-3(Fall 1970).

An x-ray fluorescence analyzer for determination of light elements is described. The instrument includes a radioisotope source chamber, a flow-through proportional counter, and four sample chambers. Radioisotope source strengths range from 0.1 to 5 mCi. Performance of the analyzer is briefly discussed. (W.H.K.)

50652 ELIMINATION OF PHASE CHANGES IN THE VARIAN HA-100 SPECTROMETER. Akkerman, P.; van Deursen, F. W. (NV Philips-Duphar, Weesp, Netherlands). J. Phys., E; 3: 811-13(Oct 1970).

Unwanted change of phase in the Varian HA-100 NMR spectrometer, which is particularly apparent in the frequency sweep mode, is eliminated by insertion of a phase compensation network in the reference signals of the synchronous audio detectors. (auth) (UK)

50653 LOW-NOISE CRYOGENIC AMPLIFIER BASED ON THE JOSEPHSON EFFECT. Van der Ziel, A.; Choe, H. M. (Univ. of Minnesota, Minneapolis). Electron. Lett.; 6: 576-7 (3 Sep 1970).

It is shown that an amplifier based on f.m. modulation of the frequency generated by a Josephson junction can have a very low-noise figure, and that it can handle voltages as small as 10^{-12} V. (auth) (UK)

Radiation Effects on Instruments and Instrument Components

Refer also to abstracts 51780, 51788, and 51812.

50654 (NP-18443) MATHEMATICAL MODEL OF THE MOS TRANSISTOR SUBJECTED TO HIGH ENERGY RADIATION. Giraud, Jean-Louis (Toulouse Univ. (France). Faculte des Sciences). 1970. 113p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis.

A simple mathematical model was established representing the electronic processes taking place in MOS transistors; the possibility of programing the calculation was taken into account. The physical phenomena induced by the irradiation of the device were then considered in detail, in particular the threshold potential and the variation of the mobility of the charge carriers in the channel. The radiations used were ^{60}Co gamma rays, 14 MeV neutrons, 600 MeV protons and 4.5 and 13 MeV beta particles. An expression was derived for the degradation undergone, which was used to adapt the already established model to the case of an irradiated device. The various radiations used enabled the general case of radiation interaction with the material to be appreciated. (auth) (France)

50655 (SC-DR-69-419) A NEW TECHNIQUE FOR THE DIRECT MEASUREMENT OF MINORITY CARRIER BASE TRANSIT TIME IN THE JUNCTION TRANSISTOR. Sullivan, W. H. (Sandia Labs., Albuquerque, N. Mex.). Sep 1969. 52p. Dep. NTIS.

An entirely new technique for the direct measurement of the junction transistor minority carrier base transit time is presented. The physical origin and significance of this device parameter are reviewed briefly and it is shown that this parameter can be measured only at low frequencies (relative to the transistor's alpha cutoff frequency). A detailed description of a precision low frequency propagation delay time bridge is then presented, and the use of this device in measuring base transit time is described. Finally, a number of potential applications of this technique are discussed briefly including the design of high-frequency radiation-hardened systems. (auth)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

50656 ASSESSMENT CRITERIA FOR BIOCHEMICAL METHODS USED IN EXPERIMENTAL RADIOBIOLOGY AND THEIR INFLUENCE ON INTERPRETATION OF RESULTS. Gerber, G. B. (EURATOM, Mol, Belg. CEEN, Mol, Belg.). pp 1-21 of Biochemisch Nachweisbare Strahlenwirkungen und Deren Beziehungen zur Strahlentherapie. /Gerber, Georg B. (ed.). Stuttgart; Georg Thieme Verlag (1970). (In German).

From Conference on Society of Radiation Biology, Stuttgart, Germany. See CONF-690551.

Discussed are problems of radiation dosimetry and maintenance of laboratory animals. In the design of experimentation, it is important to treat irradiated and control animals in the same manner. Food uptake in rabbits and rats is much more reduced following radiation than that in hamsters, guinea pigs, and mice. Therefore, biochemical experiments on irradiated animals in comparison with well-fed controls are meaningless, especially as to enzyme activity and metabolic rates of carbohydrates, fat and amino acids. Examples are described. Rules for studying metabolic processes in organs from concentration measurements in body fluids are established and the proper use of radioisotope-labeled compounds is discussed. (H.B.G.)

Basic Processes

Refer also to abstracts 50899, 50967, 50968, 50976, 50978, and 51056.

50657 (ACRH-1000-212) PREPARATION AND CONTROL OF ^{99m}Tc RADIOPHARMACEUTICALS. Lathrop, Katherine A. (Argonne Cancer Research Hospital, Chicago, Ill.). [1970]. 16p. (CONF-700517-5). Dep. CFSTI.

From Preparation and Control of Radiopharmaceuticals Conference, Vienna, Austria.

Methods used for the preparation of ^{99m}Tc-labeled compounds for use in scanning are described. The procedure used for the separation of ^{99m}Tc from ^{99}Mo in a liquid-extraction generator is first described and methods for incorporation of ^{99m}Tc in $NaTcO_4$ solutions, sulfur colloids, iron complexes, albumin solutions, and albumin microspheres are described in detail. (C.H.)

50658 (LA-4496) PRODUCTION OF ALGAE CONTAINING 93 PERCENT ^{13}C. Fowler, Eric B.; Kollman, Victor H. (Los Alamos Scientific Lab., N. Mex.). May 1970. Contract W-7405-eng-36. 4p. Dep. CFSTI.

Carbon-13 was biologically incorporated into Chlorella pyrenoidosa to the 93% level with no observable induction period or gross changes in cell morphology or size. (auth)

50659 (TID-25506) CONSIDERATION OF RADIONUCLIDE LABELS FOR MULTIPLE SIMULTANEOUS SPACE ESTIMATION. Studer, R.; Potchen, E. J. ([Washington Univ., St. Louis, Mo. Dept. of Radiology]). [1970]. 6p. Dep. CFSTI.

The stability of ^{131}I-labeled human serum albumin and of ^{51}Cr- or ^{59}Fe-labeled erythrocytes for use in the assessment of regional vascular spaces and the transcapillary movement of proteins from intra- to extravascular tissue compartments in animals were studied. Rats were injected with ^{51}Cr- or ^{59}Fe-labeled erythrocytes and the fate of the labeled cells was determined by assaying blood, spleen, liver, and kidney at various times from 5 min to 28 hrs following injection. Additional assays for ^{59}Fe-erythrocytes were made for nine days. Attempts were made to follow the movement of ^{131}I-human serum albumin in rats from 5 min to 24 hr following injection. Results were inconclusive. (C.H.)

50660 (UR-49-1347) QUANTITATIVE THERMAL NEUTRON ACTIVATION ANALYSIS IN THE MOUSE AND IN HUMAN CADAVER SPECIMENS. Weber, David Alexander (Rochester Univ., N. Y.). 1970. 113p. Dep. CFSTI.

Thesis.

A quantitative analysis of the thermal neutron (n,γ) reaction products was made in experimental laboratory animals and in human cadaver specimens. An investigation was made to determine the feasibility of thermal neutron activation analysis as a technique for estimating the weights of certain elements in vivo and in vitro. The neutron flux in the hohlraum of a TRIGA reactor was precisely calibrated using thin gold foils whose activity was determined by $\beta-\gamma$ coincidence measurements. The resonance neutron flux was evaluated from measurements of the cadmium ratio. The neutron field was used to irradiate mice and fingers from a human cadaver at low fluence levels. Neutron flux homogeneity in the specimens was evaluated from a series of gold foils and from phantom irradiations. The γ-emitting activation products in the specimens were measured with a nominal 30 cc Ge (Li) detector and a 7" × 5" NaI (Tl) detector. The Ge (Li) detector was used to determine the γ-emitting radionuclides resulting from the neutron activation; the NaI (Tl) detector provided the data necessary for determination of the individual component intensities. The reactor provided a constant flux of highly thermalized neutrons with which to perform all sample irradiations. Measurements of the γ-emitting activity in irradiated phantoms indicated that the induced activity was directly proportional to element weight for solutions containing the range of element weights and volumes presented by the tissue specimens. Small local flux perturbations observed in gold foils placed in various regions in the irradiated specimen did not significantly affect this proportionality. Radioisotopes of sodium, chlorine, and calcium were detected in all tissue specimens following neutron irradiation. In addition, a radionuclide of magnesium was identified in the finger specimens and a radionuclide of manganese was identified in the mice. A linear least-squares method of analysis of the activation product data was used to solve for the relative intensities of these contributing radionuclide components. This assay allowed calculation of the weights of the respective endogenous stable elements in the specimens. Duplicate measurements of calcium content were made in selected specimens by atomic absorption. The procedure developed in this investigation provides a method by which the weights of certain elements can be determined with a relatively low radiation dose. (auth)

50661 RESISTANCE OF TRITIUM ACTIVITY IN ADENINE-2,8-T LABELED RABBIT SPERM. Kopecny, V. (Lab. of Animal Genetics, Libechov, Czech.); Trebichavsky, I. Ann. Biol. Anim., Biochim., Biophys.; 9: 463-73(1969).

Rabbit spermatozoa were labeled in vivo by injecting a male with 6 mCi of 2,8-T-adenine. On day 49 after injection, a suspension of spermatozoa from caudae epididymidis and ductus deferentes was prepared in saline. Sperm samples were stored frozen at -5°C, exposed to autolysis for 10 days at +37°C, and smeared. Smears from freshly obtained sperm were hydrolyzed with 1 N HCl or extracted with TCA. All smears were coated with Kodak stripping film AR.10 and the autoradiographs obtained were evaluated quantitatively. No marked difference was detected between fresh and frozen + autolyzed sperm in grain number/sperm head. Graphical and statistical analyses confirmed the non-significance of differences. Accuracy of the autoradiographic method used is supposed to be sufficient to exclude considerable loss of activity from the sperm heads. Standard deviation of repeated determination of mean grain count in the same slide amounts approximately to 5 per cent. On the contrary, complete loss of activity was detected in hydrolyzed and extracted smears. Presence of some activity in the autolysed sperm medium in a substance utilizable by bacteria was revealed in a few labeled bacterial colonies. Ultrastructure of the sperm nucleus was well preserved even after autolysis and did not show any sign of major deoxyribonucleoprotein loss. (auth)

50662 RADIOIMMUNOASSAY FOR QUANTIFYING CARBONIC ANHYDRASE ISOZYMES IN CRUDE LYSATES. Headings, Verle E.; Tashian, Richard E. (Univ. of Michigan, Ann Arbor). Biochem. Genet.; 4: 285-95(Apr 1970).

A radioimmunoassay method was developed for quantifying each of the two genetically distinct forms of primate carbonic anhydrase, carbonic anhydrases I and II, in unpurified lysates. Under the given experimental conditions, the assay is capable of detecting a minimum of 0.025 μg of carbonic anhydrase I and 0.005 μg of carbonic anhydrase II. There is approximately 98% reproducibility upon repeated assays of a given hemolysate. (auth)

50663 THE DEVELOPMENT OF A RADIOIMMUNOASSAY FOR OXYTOCIN: RADIOIODINATION, ANTIBODY PRODUCTION, AND SEPARATION TECHNIQUES. Chard, T.; Kitau, M. J.; Landon, J. (St. Bartholomew's Hospital, London). J. Endocrinol.; 46: 269-78(1970).

A simple and rapid method is described for labeling oxytocin with ^{131}I at a high specific activity. This method is compared with previously described methods. A satisfactory antiserum was raised by direct intra-lymph node injection of oxytocin adsorbed to carbon microparticles. A number of methods for separating

antibody-bound from free oxytocin are described, and reasons given for preferring a procedure using ammonium sulphate precipitation. These data form the basis for developing a radioimmunoassay method intended for the determination of oxytocin in human plasma. (auth)

50664 RADIOIMMUNOASSAY FOR HUMAN FOLLICLE STIMULATING HORMONE: PHYSIOLOGICAL STUDIES. Odell, W. D.; Parlow, A. F.; Cargille, C. M.; Ross, G. T. (Harbor General Hospital, Torrance, Calif.). J. Clin. Invest.; 47: 2551-62(1968).

A sensitive and specific radioimmunoassay for FSH was developed that is 500 to 1000 times more sensitive than the rat ovarian weight augmentation assay and that is capable of quantifying FSH in small volumes of serum. Anti-FSH was prepared by immunizing rabbits with an impure FSH preparation. The majority of antisera showed complete inability to distinguish LH, TSH, and FSH, illustrating the immunological similarities of these hormones. One antiserum was specific when used in a radioimmunoassay. Potency estimates by bioassay were in good agreement, with a single exception, with those obtained with the radioimmunoassay for 10 FSH containing preparations. Highly purified LH gave a higher potency by immunoassay than by bioassay. Sera from eugonadal men contained 5-25 mIU/ml; sera from castrate men contained over 30 mIU/ml. Sera from eugonadal women contained 7-25 mIU/ml during the follicular phase and 5 to 15 mIU/ml during the luteal phase of the menstrual cycle. Sera from castrate or postmenopausal women contained 40 to 250 mIU/ml. FSH was measured throughout the menstrual cycle in 19 women. There is a small early follicular phase rise in FSH, and then FSH is relatively constant until mid cycle; in the majority of women a mid cycle rise of FSH occurs coincidentally to the mid cycle LH ovulatory peak; during the luteal phase FSH levels are relatively constant and lower than during the follicular phase. Nonsequential oral contraceptives containing estrogen and progesterone abolish these changes and FSH concentrations remain low throughout treatment. Treatment of castrate men and castrate or postmenopausal women with high doses of oral estrogens results in a fall of FSH to levels found in eugonadal men or women, but not to undetectable levels. Children less than 5 yr of age had undetectable FSH (>5 mIU/ml). (auth) (Excerpta Med.)

50665 STUDIES ON PROLACTIN IN CATTLE BLOOD USING A RADIO-IMMUNOLOGICAL METHOD OF TREATMENT. Schams, D.; Karg, H. (Technische Hochschule, Munich). Zentralbl. Veterinaermed., Reihe A; 17: 193-212(Mar 1970). (In German).

A radio-immunological technique, using the bovine pituitary preparation NIH-P-B2 as antigen, was used to estimate prolactin in cattle blood. Testing the specificity of the method showed purity of the standard preparation and specificity of the antisera. There were occasional cross-reactions with sheep prolactin but not with other pituitary hormones. Samples taken at the same times of day over long periods showed closer relationships of the prolactin level to the season than to stage of lactation or milk yield. Of particular note was a high level lasting for several hours immediately before calving. There were no marked differences between the basic values in the dry period and during lactation. In relation to the estrous cycle there were no accentuated prolactin levels that would suggest a luteotropic action of the hormone. The most prominent findings were marked changes in the blood level during each 24-hour period that suggested frequently changing rhythm of the hormone. This was consistent with the very short persistence time of prolactin in blood (a half time of about 25 minutes) which is revealed by exogenous administration. In some cases there was a temporary rise in prolactin immediately after milking. After withholding food for 24 hours, there was a reduction of the absolute value but no effect on the daily variations. These variations between the 24 hours also occurred in non-lactating animals like heifers and bulls. The findings showed that the prolactin levels in the blood are not a suitable parameter for the assessment of lactation but represent an effect of this hormone in conjunction with other metabolic factors. (auth)

50666 STUDIES ON THE SPECIFICITY OF THE RADIOIMMUNOASSAY OF LUTEINIZING HORMONE. Buckler, J. M. H.; Clayton, Barbara E. (Hospital for Sick Children and Inst. of Child Health, London). Acta Endocrinol.; 63: 545-61(1970).

The cross reaction of follicle stimulating hormone (FSH) with antisera raised to human chorionic gonadotropin (HCG) for use in the radioimmunoassay of luteinizing hormone (LH) was found to be influenced by many factors. These included the relative concentration of the hormones, the concentration of antiserum, the length of the assay stages, and the particular preparation of FSH. Antisera do not react identically with HCG and LH. This effect varied from antiserum to antiserum and so does the ability to detect the immunological differences which became apparent between different preparations of FSH and between hormones of urinary and pituitary origin. These findings were of considerable relevance to the assessment of the validity of a radioimmunoassay system. (auth) (Denmark)

50667 RADIOIMMUNOASSAY FOR PARATHYROID HORMONE IN MAN. II. MEASUREMENT OF PARATHYROID HORMONE CONCENTRATIONS IN HUMAN PLASMA BY MEANS OF A RADIOIMMUNOASSAY FOR BOVINE HORMONE. Lequin, R. M.; Hackeng, W. H. L.; Schopman, W. (Lab. for Endocrinological Chemistry, Rotterdam). Acta Endocrinol.; 63: 655-66 (1970).

With a guinea-pig antiserum against bovine PTH, human PTH could be measured in plasma. PTH-levels were expressed in terms of equivalents b/PTH per ml. In normal, adult subjects the mean plasma PTH concentration was 140 pg b-PTH eq./ml with a range of non-detectable (<70) to 200 pg b-PTH eq./ml. Patients with primary hyperparathyroidism showed overlap with the normal range; in secondary hyperparathyroidism the levels were usually far higher. The PTH levels in patients with a variety of disorders involving calcium metabolism were studied. (auth) (Denmark)

50668 RADIOIMMUNOASSAY FOR PARATHYROID HORMONE IN MAN. I. DEVELOPMENT OF A RADIOIMMUNOASSAY FOR BOVINE PTH. Schopman, W.; Hackeng, W. H. L.; Lequin, R. M. (Lab. for Endocrinological Chemistry, Rotterdam). Acta Endocrinol.; 63: 643-54(1970).

Bovine parathyroid hormone (PTH) was purified up to the Sephadex-stage. The biological activity of the preparations was about 2000 U/mg solid material. Rabbits and guinea-pigs were immunized with crude and Sephadex-purified material. Antisera elicited in two guinea-pigs proved to be useful for further studies. Purification of ^{131}I-labelled bovine PTH was carried out by adsorption to and desorption from antibodies or by means of microfine silicate. The purified labeled hormone showed excellent binding to the antibodies. Maximum sensitivity of the assay system of 10 pg per incubation medium could be achieved by a pre-incubation method. The selectivity of the system was studied. (auth) (Denmark)

50669 LABELLING OF SNAKE VENOMS WITH RADIOACTIVE ISOTOPES. Lebez, D. (Nuclear Inst. Jozef Stefan, Ljubljana, Yugoslavia). pp 75-86 of Radiation Sensitivity of Toxins and Animal Poisons. Vienna; International Atomic Energy Agency (1970).

From Panel on the Radiation Sensitivity of Toxins and Animal Poisons, Bangkok, Thailand. See STI/PUB-243; CONF-690555.

In-vivo labeling of snake venom with ^{65}Zn was accomplished. Appreciable amounts of radioactivity were found in the venom. Selenium-75, in the form of selenomethionine, was used to label the venom of Vipera ammodytes in our laboratory. Results show that selenium was incorporated into the venom to a great extent. The biological exchange of sulfur with selenium in protein molecules is a favorable procedure as the natural structure of the toxin is not seriously disturbed. It was shown on many other proteins that their biological and biochemical properties remain unchanged when sulfur is substituted for selenium. (auth)

50670 BIOCHEMISTRY. pp 227-379 of Handbook of Radioactive Nuclides. /Wang, Yen (ed.). Cleveland; Chemical Rubber Company (1969).

The biochemistry of commercially available radioisotopes and of labeled organic compounds is discussed. The discussion includes the following major topics: standards of radioisotope activity; radioisotope dilution analysis; improved solubilization procedures for liquid scintillation counting of biological materials; sample preparation for liquid scintillation counting; the stability of labeled organic compounds; storage and stability of compounds labeled with various radioisotopes; and synthesis of labeled compounds. Tables containing data on self-decomposition and self-radiolysis of labeled compounds and the schemes for the organic synthesis of ^{14}C-, ^{35}S-, ^{32}P-, and ^{36}Cl-labeled compounds are presented. A literature section is included that cites 181 references. (E.R.B.)

50671 RADIOISOTOPE STUDIES ON FASCIOLA GIGANTICA INFECTION OF CATTLE. Bitakaramire, P. K. (University Coll., Nairobi, Kenya). pp 35-43 of Isotopes and Radiation in Parasitology. Part II. Vienna, International Atomic Energy Agency (1970).

From Meeting on the Use of Isotopes and Radiation in Studies of Parasitic Diseases in Domestic Animals, Vienna, Austria. See STI/PUB-242; CONF-690642.

Preliminary experiments were carried out with ^{51}Cr-labelled red cells and ^{125}I-labelled albumin on cattle infected with Fasciola gigantica and on control worm-free animals. In most cases the parasite burden in the infected cattle was too small to produce marked differences between them and the controls. It was clear, however, that very rapid elution of ^{51}Cr from the bovine red cells took place in vivo and for this reason the analysis of disappearance curves in the assessment of red cell loss is much less satisfactory with cattle than with other species studied so far. (auth)

50672 ISOTOPE TECHNIQUES IN THE STUDY OF HYPOPROTEINAEMIAS ASSOCIATED WITH HELMINTHIC DISEASE. Nielsen, K.; Nansen, P. (Royal Veterinary and Agricultural Coll., Copenhagen). pp 63-9 of Isotopes and Radiation in Parasitology. Part II. Vienna, International Atomic Energy Agency (1970).

From Meeting on the Use of Isotopes and Radiation in Studies of Parasitic Diseases in Domestic Animals, Vienna, Austria. See STI/PUB-242; CONF-690642.

The salient features of work with isotopically labelled serum proteins in large animals are outlined. Special attention is given to homogeneity of protein preparations, damage by self-irradiation, steady-state criteria and calculation methods. Results from work with labelled albumin and IgG slow in parasitized cattle and sheep are summarized. Interpretation of the cause of increased IgG metabolism should include consideration of the positive feed-back mechanism existing between the serum concentration of IgG and the catabolic rate. The significance of this phenomenon is discussed with particular reference to possible immune mechanisms in helminthic infections. Future work should include studies with serum immunoglobulins other than IgG slow. The possible significance of IgG fast as a local antibody on mucosal surfaces is discussed. Kinetic studies with this IgG subclass in helminthic diseases are needed. (auth)

50673 METHOD OF STUDYING FOOD CONSUMPTION OF LIVE HONEY BEE LARVAE BY LIQUID SCINTILLATION COUNTING. Dietz, Alfred; Lambremont, Edward N. (Louisiana State Univ., Baton Rouge). Ann. Entomol. Soc. Amer.; 63: 1340-2 (Sep 1970).

A radioisotope method was developed to study the continuous food intake of individual honey bee larvae, Apis mellifera, from hatching until they become prepupae. The amount of ^{32}P-labeled royal jelly eaten during this developmental period was measured directly in living larvae by analyzing their ^{32}P content by liquid scintillation counting in a special vial designed to isolate the insect from the liquid scintillation fluid. The procedure is applicable for insects with a maximum weight up to about 25 mg. For larger organisms, a correction factor for self-absorption of radiation can be applied. (auth)

Metabolism, Physiology, and Toxicology

Refer also to abstracts 50556, 50868, 50873, 50880, 50894, 50896, 50918, 50954, 50996, and 51051.

50674 (BNWL-1306(Pt.1)) PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1969 TO THE USAEC DIVISION OF BIOLOGY AND MEDICINE. VOLUME I. LIFE SCIENCES. PART 1. BIOLOGICAL SCIENCES. Thompson, R. C. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug 1970. Contract AT(45-1)-1830. 90p. Dep. CFSTI.

Research activities in the biological sciences section of the Division of Biology and Medicine at Pacific Northwest Laboratories during 1969 are reported. The 40 projects reported on are presented under the following general headings: gastrointestinal irradiation studies; effects of irradiating skin; radiation and human spermatogenesis; radiation effects on chylomicron synthesis and capillary permeability in mice; cellular regulatory mechanisms; fine structural effects of temperature in fish; metabolism and effects of radionuclides in the developing fetus and the young; effects of radioiodine in sheep and swine; effects of radiostrontium in miniature swine; inhalation studies; radiation-induced leukemogenesis in miniature swine; low level plutonium inhalation studies in beagles; inhalation hazards to uranium miners; space nuclear systems studies; removal of internal emitters; development and evaluation of blood irradiators; and malonaldehyde as a radiolysis product of biological materials. (E.R.B.)

50675 (BNWL-1306(Pt.2), pp 3.1-25) AQUATIC ECOLOGY. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1969, Vol. 1, Pt. 2.

The research activities of the aquatic ecology section during 1969 are reported. The 20 projects reported on are presented under the following headings: ecologic characteristics of the Columbia River, freshwater ecology of Rattlesnake Springs, and rates and mechanisms of biogeochemical processes in the Columbia River (7 reports); effects of modifications on Columbia River ecosystems (5 reports); and effects of modifications of Columbia River ecosystems—related studies (8 reports). The publications and presentations of the staff members during the reporting period are listed. (E.R.B.)

50676 (CONF-691212-, pp 239-52) DISTRIBUTION AND RADIOBIOLOGICAL BEHAVIOR OF COLLOIDS AND MACROAGGREGATES. Nelp, Wil B. (Washington Univ., Seattle. School of Medicine).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8-11, 1969.

The radiation dose to the lung from current lung-scanning particles and factors that influence their trapping and residence time are reviewed. The radiation dose to the lung is governed by the biologic half-life of the radioactive label in the lung and the radiation characteristics of the label. Macroaggregated albumin has a biologic half-life of 6 to 8 hr. With the ^{131}I label, the dose increases almost linearly as the biologic half-life increases. Iron hydroxide aggregates or albumin microspheres labeled with ^{99m}Tc or ^{113m}In give lung doses eight times less even though the biologic half-life of the particle may be 12 hr or more. To estimate the radiation dose from radiocolloids used in clinical nuclear medicine, one must be able to estimate the fraction of the dose distributed to the various organs and the organ size. Organ distribution is influenced by particle size, organ blood flow, and the disease state. Methods to estimate liver and spleen size are discussed. The ^{99m}Tc-sulfur colloid and ^{113m}In colloids concentrate more avidly in the spleen than colloidal ^{198}Au, but with all agents the major fraction of the dose (80 to 90%) goes to the liver. The effective half-life of these radiocolloids in the reticuloendothelial system is that of the physical half-life of their labels. (auth)

50677 (COO-119-241) RETENTION AND DOSIMETRY OF SOME INJECTED RADIONUCLIDES IN BEAGLES. Lloyd, Ray D. (comp. and ed.) (Utah Univ., Salt Lake City. Radiobiology Div.). Mar 1970. Contract AT(11-1)-119. 162p. Dep. CFSTI.

Separate abstracts were prepared for the nine papers appearing in this report. (E.E.H.)

For abstracts of individual papers see: 50678-50684, 50895, and 50896.

50678 (COO-119-241, pp 25-59) RADIUM AND MESOTHORIUM RETENTION AND SKELETAL DOSIMETRY IN BEAGLES. Lloyd, Ray D.; Mays, Charles W.; Atherton, David R.; Van Dilla, Marvin A. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Retention and dosimetry of some injected radionuclides in beagles.

Radium retention was determined in 125 Beagles injected with ^{226}Ra and in 78 Beagles injected with ^{228}Ra. The radionuclides were administered intravenously in a citrate buffer solution when the animals were about 1.5 yr of age. Retention measurements now extend to more than 14 yr after injection (for dogs nearly 16 yr of age) so that future revision of the radium retention equations appears unlikely since the median survival time in our control beagles is about 11.3 yr after injection (about 12.7 yr of age). Dogs injected with 10 μCi ^{226}Ra/kg had a higher retention than those receiving 3 μCi ^{226}Ra/kg. This is interpreted as a consequence of radiation damage to the bone remodeling processes at high ^{226}Ra concentrations. Total-body retention of injected radium in the 10 μCi/kg dogs during the first 1400 days after injection was as if about 41% was retained with a biological half-time of 1 day, 10% with 10 days, 20% with 142 days, and 29% with 2318 days. Radium retention during the first 5200 days by animals receiving lower ^{226}Ra injections of 3 μCi/kg or less and by animals injected with ^{228}Ra was as if about 25% was retained with a biological half-time of 1 day, 21% with 3 days, 21% with 43 days, 18% with 347 days, and 15% with 4621 days. The average skeletal radiation dose rate and cumulative radiation dose were calculated for Beagles receiving ^{226}Ra or ^{228}Ra injections using the appropriate retention equation. Allowance was made in the ^{226}Ra calculations for the changing skeletal retention of ^{222}Rn and its radioactive daughters, and in the ^{228}Ra calculations for the diminution of ^{228}Ra activity by radioactive decay as well as for the ingrowth and skeletal retention of ^{228}Th and its radioactive daughters. Radiation dose parameters for each dog were adjusted by his individual retention measurements. (auth)

50679 (COO-119-241, pp 60-8) DISTRIBUTION OF INJECTED ^{226}Ra IN THE BEAGLE SKELETON. Mays, Charles W.; Lloyd, Ray D.; Atherton, David R. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Retention and dosimetry of some injected radionuclides in beagles.

The ^{226}Ra content of individual bones from nine adult Beagles dying 1 to 2099 days after the injection of 0.163 to 10.6 μCi ^{226}Ra/kg was determined by γ-ray counting. Bones were sealed in cans and frozen. About 24% of the retained skeletal radium was in the head and neck, 30% in the rib cage and thoracic and lumbar spine, 19% in the forelimbs and shoulder girdle, 23% in the hindlimbs and hip girdle, and 2% in the tail. The fraction of retained skeletal radium accounted for by some bones appeared to be dependent upon time after injection. This relation was statistically significant for thoracic vertebrae (negative slope) and for cervical vertebrae, hindpaws, and forepaws (positive slope). In no case did the absolute value of the calculated slope exceed 1% of the retained total skeletal radium per year. There was a significant difference between the animals injected with about 10 μCi/kg and those given less ^{226}Ra in the relative distribution of retained activity in bones containing much trabecular or much cortical bone at burden times of more than one month, that is attributed to radiation damage of the bone remodeling processes in the high-level dogs. (auth)

50680 (COO–119–241, pp 69–78) FRACTIONAL RADON RETENTION IN BONE. Mays, Charles W.; Lloyd, Ray D.; Van Dilla, Marvin A. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Retention and dosimetry of some injected radionuclides in beagles.

Radon-to radium ratios have been measured in bones of 49 Beagles dying 5 to 2988 days after the intravenous injection of ^{226}Ra. The expression $Rn/Ra = 7.5\% \; t^{0.154} \; (1-e^{-0.181t})$ at t days describes the dependence of the Rn to Ra ratio in these bones upon time after administration. The equation appears valid for dogs that received their radium in six equal injections spaced over a period of 280 days, when t is considered as time after mid-injection. Comparison of results for dogs with those reported for mice, rats, chinchillas, and humans suggests that skeletal Rn/Ra ratios as a function of time may be species independent. (auth)

50681 (COO–119–241, pp 79–96) RETENTION AND SKELTAL DOSIMETRY OF INJECTED ^{90}Sr IN BEAGLES. Lloyd, Ray D.; Mays, Charles W.; Taylor, Glenn N. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Retention and dosimetry of some injected radionuclides in beagles.

The retention of ^{90}Sr was determined by whole-body counting in a group of 96 Beagles given 0.517 to 302 μCi ^{90}Sr/kg body mass by intravenous injection at about 1.4 yr of age. Retention measurements now extend to nearly 5000 days (13.5 yr after administration. Total-body retention of injected ^{90}Sr was as if about 36% was retained with a biological half-time of one day, 29% with six days, 10% with 76 days, 12% with 365 days, and 13% with 4621 days. Using this retention function, the average skeletal radiation dose rate and cumulative skeletal radiation dose from $^{90}Sr + {}^{90}Y$ was calculated. Allowance was made in the calculations for the effects on dose and dose rate of skeletal mass, diminution of ^{90}Sr concentration by radioactive decay, the escape of β-energy from bone, and the measured retention of each individual dog. (auth)

50682 (COO–119–241, pp 97–104) DISTRIBUTION OF INJECTED ^{90}Sr IN THE BEAGLE SKELETON. Lloyd, Ray D.; Mays, Charles W. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Retention and dosimetry of some injected radionuclides in beagles.

The ^{90}Sr content of individual bones from two dogs dying 1740 and 2256 days after the injection of about 100 μCi ^{90}Sr/kg was determined by β-counting. Bones were ashed and dissolved in nitric acid. Counting was done with a well-type plastic scintillator. Distribution of the retained ^{90}Sr was about 35% of the skeletal ^{90}Sr in the head and neck, about 21% in the rib cage and thoracic and lumbar spine, about 20% in the forelimbs and shoulder girdle, about 23% in the hind limbs and hip girdle, and about 1% in the tail. Comparison of the $^{90}Sr/Ca$ ratios in bone samples from a dog dying 14 days after injection and of bone samples from a dog sacrificed 9 days after injection with those in corresponding bone samples from a dog dying 1448 days after injection showed that, for dogs injected as young adults, cortical bone initially takes up injected ^{90}Sr less avidly than did trabecular bone. Since cortical bone turns over more slowly, this marked difference in labeling is not seen at times long after injection. (auth)

50683 (COO–119–241, pp 105–22) DISTRIBUTION AND RETENTION OF INJECTED ^{210}Pb IN THE BEAGLE. Lloyd, R. D.; Mays, C. W.; Atherton, D. R.; Bruenger, F. W. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Retention and dosimetry of some injected radionuclides in beagles.

Lead-210 was administered to 10 young adult Beagles as an intravenous injection in a citric acid sodium citrate buffer solution at pH 3.5. Retention was determined by whole-body counting of the 47 keV γ ray. Total excreta collections from three dogs for the first 3 weeks after injection were assayed intact by γ-ray counting. About ¾ of the excreted ^{210}Pb appeared in the feces. The fraction of the injected activity still in the circulating blood was about 0.40 at 1 day, 0.14 at 1 week, and 0.03 at 1 month. By 1 hr following injection, red cells had more than 99% of the ^{210}Pb in the blood. Preliminary results indicate that during the first 700 days, 36% of the injected Pb is retained in the dog with a biological half-time of 4 days, 43% with 33 days, and 21% with 990 days. One dog sacrificed 28 days after injection had about 63% of the retained Pb in the skeleton, 20% in the liver, 8% in the blood, and 9% in other soft tissues. Liver had the highest ^{210}Pb concentration of any tissue measured, 1.6 times that in the skeleton. (auth)

50684 (COO–119–241, pp 123–43) ^{241}Am RETENTION IN BEAGLES. Lloyd, R. D.; Mays, C. W.; Taylor, G. N.; Atherton, D. R. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Retention and dosimetry of some injected radionuclides in beagles.

Forty-eight adult beagles were injected with 0.00179 to 4.49 μCi ^{241}Am/kg body mass. Retained activity in the living animals was evaluated via the 60 keV γ ray using a combination of whole-body and partial-body counting to determine the proportion in the liver and in non-liver tissue. Soon after injection, about 50% and 40%, respectively, of the administered ^{241}Am was deposited in the liver and non-liver tissue (mainly skeleton). In the animals injected with 0.00179 to 0.305 μCi/kg the liver and non-liver, burdens decreased slowly, each with a biological half-time of about 10 yr during the first 850 days. Two dogs injected with about 2.80 μCi/kg exhibited a sharp decrease in liver retention beginning about 100 days after injection accompanied by an increase in non-liver ^{241}Am. Both showed extreme degenerative liver changes at death 401 and 448 days after injection. Similar, but more slowly progressing, effects were observed in the retention of ^{241}Am by two animals injected with about 0.904 μCi/kg. At even longer times after injection, corresponding effects were noted in the lower level dogs. Excreta collections from four dogs during the first three weeks after injection showed that ⅛ of the excretion was urinary and that nearly ¾ of the total ^{241}Am excreted during this period appeared in the first day's collection. Evaluation of the activity of individual bones, organs, and tissues of six animals autopsied 1 to 448 days after injection showed that, although ^{241}Am was distributed in many soft tissues, the liver and skeleton were the principal deposition sites. Americium concentration in the thyroid gland was higher than in the skeleton and in any other soft tissue except the liver. Autoradiography showed that ^{241}Am was deposited close to the location of the functioning thyroid cells. The kidney also had a relatively high concentration of activity, selectively deposited in the glomeruli. (auth)

50685 (TID–25500) COMPARISON OF "OH" AND "PO_4" BUFFERS ON THE ORGAN DISTRIBUTION OF INDIUM COLLOIDS IN THE RAT. Adatepe, M. H.; Studer, R.; Welch, M.; Potchen, E. J. (Washington Univ., St. Louis, Mo. Dept. of Radiology). [1970]. 7p. Dep. CFSTI.

The relative organ distribution of ^{113m}In colloid made with phosphate buffer or the addition of sodium hydroxide with and without gelatin were studied in rats. Results showed that a pH distinction of organ specificity is not as critical with the phosphate buffer as it is with hydroxide buffer. The mechanism for this variation appears to be related to the size of the colloid particles formed which depends upon the dissociation constant of indium phosphate versus indium hydroxide. This has clinical importance when one is designing simplified organ specific techniques to prepare an eluate for liver, spleen, and bone marrow scanning. (auth)

50686 (UCRL–72589) FATE OF FALLOUT INGESTED BY LIVESTOCK; SWINE. Chertok, Robert J.; Lake, Suzanne (California Univ., Livermore. Lawrence Radiation Lab.). 7 Aug 1970. 11p. (CONF-700909–1). Dep. NTIS.

From Symposium on Survival of Food Crops and Livestock in the Event of Nuclear War, Upton, N. Y.

The increased use of nuclear energy necessitates thorough investigation of the biological availability of radionuclides released to the biosphere. The radionuclides produced by a nuclear event occur in a variety of chemical and physical forms and are associated with particles of various sizes. Therefore, distribution or retention data from laboratory experiments with a single pure radionuclide cannot reasonably be extrapolated to a radionuclide in a complex mixture as in debris. The Plowshare nuclear cratering experiments offer a unique opportunity to study the biological availability of radionuclides associated with debris from nuclear detonations. The retention and excretion of the γ-emitting radio-

nuclides produced by three Plowshare detonations and one other event were determined. Near-surface atmospheric debris was administered orally to the experimental animals (two for each study) which were then confined to metabolic cages for the duration of the experiment (5 to 9 days). For two events, the experimental animals were beagles and for two other events they were peccaries (Tayassu tajacu). Daily whole-body analyses were performed with a lithium-drifted germanium (GeLi) detector. Daily collections of urine and feces were analyzed similarly on the same detector. In these studies, the percentage of dose absorbed is the sum of the percentage excreted in the urine and the percentage remaining in the whole body at the conclusion of the experiment. The results indicate that for some radionuclides the percentage absorbed varies not only from literature values but also from event to event. Admittedly these differences may be due to species differences, but it is more likely that they are due to variations in the chemical and/or physical form of the radionuclide in the debris of different events. For the radionuclides analyzed so far, ranges of absorption for the four events are as follows: ^{54}Mn (1.0%), ^{58}Co (4.3%), ^{74}As (45.4%), ^{88}Y (1.1%), ^{99}Mo (11.5 to 31.0%), ^{103}Ru (not detectable [N.D.] to 5.5%), ^{122}Sb (4.0 to 4.2%), ^{131}I (32.7 to 78.5%), ^{132}Te (0.9 to 24.5%), ^{140}Ba/^{140}La (0.5 to 4.1%), ^{141}Ce (N.D. to 0.5%), ^{187}W (7.0 to 41.4%), ^{189}W/^{189}Re (18.2%), and ^{198}Au (4.1 to 7.7%). The radionuclides with only one value in parentheses were measured in only one event. (auth)

50687 (UH-235-P-8-X-3) PROGRESS REPORT, MAY 15, 1970. Casarett, Louis J. (Hawaii Univ., Honolulu. School of Medicine). 15 May 1970. Contract AT(04-3)-235. 16p. Dep. CFSTI.

Following inhalation of ^{239}Pu-labeled plutonium oxide particles by dogs and rats and inhalation of ^{238}Pu-labeled plutonium oxide and ^{235}U-labeled uranium oxide particles by dogs, data were obtained for locus of deposition and redistribution of particles. Rats were exposed to chromium oxide particles for studies on phagocytosis in pulmonary cells and a table is presented to show concentration of particles in cells from one to 15 days after exposure. Alveolar cell response to dust loads was measured by means of cell counts at various periods of time after exposure. Several immunological agents were found to stimulate an alveolar cell proliferative response. Data on succinic dehydrogenase and other enzymes in alveolar cells were obtained using histochemical techniques. Studies were conducted on the origin, development, and activation of alveolar macrophages using immunological techniques. Studies were carried out on the influence of calcium and magnesium ions on phagocytosis of uranium oxide particles by peritoneal cells and the response of alveolar cells to uranium oxide ions in a chromium oxide system. (H.L.W.)

50688 THE ROLE OF THE LIVER IN ^{59}Fe KINETICS. Montz, R. (Univ., Hamburg). Nucl.-Med.; 9: 62-9(1970). (In German).

The factors that affect the results of surface measurements over the liver after administration of ^{59}Fe were determined quantitatively by means of phantom measurements. From the results and the data obtained in 200 radioiron studies of hematological patients a formula is proposed that allows the determination of the ^{59}Fe uptake by the liver and the total reticuloendothelial system, respectively. It is based on the measurement of the ^{59}Fe activity over the liver and in blood. In patients without pathologically increased turnover of depot iron, there is at any time after radioiron administration not more than an average of 4% (maximally 7 to 8%) of the injected ^{59}Fe in the liver. The iron uptake by the RES and thus the role of the liver is therefore generally so small that it can be neglected in the evaluation of ^{59}Fe kinetics. One quarter of our patients had an increased turnover of depot iron which needed to be determined quantitatively. (auth)

50689 RETENTION OF ORALLY ADMINISTERED ^{47}Ca IN MAN MEASURED IN A WHOLE-BODY COUNTER. Sjoeberg, H. E.; Reizenstein, P.; Arman, Eva (Karolinska Sjukhuset, Stockholm). Scand. J. Clin. Lab. Invest.; 26: 67-71(Aug 1970).

A method is described for studying the retention of orally administered ^{47}Ca using a whole-body counter. Two μCi ^{47}Ca were given after an overnight fast together with calcium carrier as $CaCl_2$ in water, and the retention was measured after one and two weeks. The error due to geometric and biologic variations was 1.7 per cent of the given dose. In 27 healthy subjects the retention of ^{47}Ca one week after the administration was 35.7 ± 7.6 (S.D.) per cent of the given dose and after two weeks 29.3 ± 7.4 (S.D.) per cent. (auth)

50690 EFFECT OF ANTITHYMUS SERUM ON THE ^{45}Ca AND GLYCINE-2^{14}C INCORPORATION INTO CALCIFIED TISSUES OF RATS. Averchenko, V. I. Patol. Fiziol. Eksp. Ter.; 13: No. 3, 50-3(1969). (In Russian).

Experiments were performed on male Wistar rats. Under the effect of the cytotoxic action of antithymus serum on the 15th experimental day a loss of weight of the thymus gland and a rise of weight of the spleen occurred. As a result of the administration of antithymus serum there ensued a depression of ^{45}Ca and glycine-2^{14}C incorporation into the bones and teeth of rats on the 15th and 40th experimental day. (auth)

50691 EXPERIMENTAL INVESTIGATIONS ON THE PENETRATION OF ^{198}Au FROM NASAL MUCOUS MEMBRANE INTO CEREBROSPINAL FLUID. Czerniawska, Alicja (Medical School, Bialystok, Poland). Acta Oto-Laryngol.; 70: 58-61 (1970).

Possible penetration of radioactive colloidal gold (^{198}Au) from the mucous membrane of the olfactory region of the rabbit nose into the cerebrospinal fluid of the subarachnoid space of the anterior part of the brain was studied. The highest activity of the locally injected isotope ^{198}Au was observed in the cerebrospinal fluid of the cisterns of the anterior cranial fossa during an ischaemic state of the nasal mucous membrane. A similar characteristically high activity from these sites was seen with physiological vascularization of the nasal mucous membrane. This evidence, taking into account the coexistent activity of the plasma, indicated the direct penetration of the isotope ^{198}Au from the nasal mucous membrane of the olfactory region of the rabbit nose into the cerebrospinal fluid of the anterior part of the base of the brain. (auth) (SW)

50692 BINDING OF RADIOACTIVE ISOTOPES BY COMPONENTS OF THE SKIN. Shvydko, N. S.; Il'in, L. A.; Norets, T. A.; Antonova, V. A. Med. Radiol.; 15: No. 6, 67-72(Jun 1970). (In Russian).

The quantitative distribution of radioisotopes of molybdenum, tellurium, strontium, barium, yttrium, cerium, and praseodymium with neodymium between individual biostructures of the skin and its layers was investigated. On the basis of the results a comparative analysis of behavior of these radionuclides in the skin was conducted. (auth)

50693 SKIN ABSORPTION OF PLUTONIUM IN DMSO SOLUTION. Watters, R. L.; Johnson, J. E. (Colorado State Univ., Fort Collins). Health Phys.; 19: 318-20(Aug 1970).

Dimethyl sulfoxide (DMSO) is used as a solvent for plutonium salts to avoid the hydrolysis produced in aqueous solutions. DMSO has been reported to migrate rapidly through the skin and may carry dissolved materials with it. In the case of plutonium-DMSO solutions, a serious radiological health problem could arise from skin contact. An investigation was made, using rats, of the percentage of plutonium in DMSO solution which might migrate through the skin and enter the blood. Information concerning the tissue distribution and the excretion function for plutonium in this chemical form also was obtained. It was found that the chemical form of plutonium in this solution produces lower relative bone and liver deposition than with the usual plutonium aqueous solutions. The high excretion and prolonged high blood concentrations are not typical of previous studies with other chemical forms. (auth) (UK)

50694 SKIN CLEARANCE OF IONTOPHORETICALLY ADMINISTRATED CHROMIUM (^{51}Cr) AND SODIUM (^{22}Na) IONS IN THE GUINEA PIG. Wahlberg, Jan E. (National Inst. of Occupational Health, Stockholm). Acta Dermato-Venereol.; 50: 255-62(1970).

An in vivo isotope technique (disappearance measurements) was used to compare, in the guinea pig, the skin clearance of chromate (^{51}Cr) and sodium (^{22}Na) ions after iontophoretic and epicutaneous administration. The effects of variations in the concentration of the ions, current strength and duration of current flow were especially studied. Disappearance from the skin occurred mainly during the first hour after iontophoresis. The maximal increase observed was up to 43 times greater than with epicutaneous administration for the lowest chromate concentration, and eight times greater for the sodium ions. A gradual increase in the current strength and the duration respectively, increased the skin clearance of the chromate ions, in contrast to clearance of sodium ions where it was already optimal at 2 mA at 5 min. It seems probable that iontophoretic administration can be used as a test method, complementary to ordinary patch testing, for the investigation of obscure cases of contact eczema. (auth) (SW)

50695 SELECTIVE UPTAKE OF A RADIOACTIVE DRUG INTO HUMAN TUMOR CELLS GROWING IN TISSUE CULTURE. Dendy, P. P. (Cambridge Univ., Eng.). Acta Radiol., Ther., Phys., Biol.; 8: 513-22(Dec 1969).

The uptake of 2-methyl-6:7-ditritio-1:4-maphthaquinol bis (disodium phosphate) into several cell types growing in tissue culture was studied autoradiographically. Results show that pro-

vided the drug is administered at a molarity between 1.5×10^{-6} M and 1.5×10^{-4} M the uptake into human tumor cells established in tissue culture can be as much as 100 times greater than that into freshly cultured normal cells. Outside this narrow range of molarities the enhancement is rapidly lost. (auth)

50696 BIOPHYSIQUE. TOME I. ENERGETIQUE CINETIQUE ISOTOPES. (Biophysics. Volume I. Energetics and Kinetics of Isotopes). Tonnelat, Jacques. Paris; Masson et Cie, Editeurs (1968). 410p.

The elements of energetics and their application to the basic phenomena of metabolism are studied. The basic principles of thermodynamics and biophysics are reviewed. It is shown how these relations established for perfect gases can be applied to the study of solutions. Phenomena of osydo-reduction, which play an important role in energy exchanges for organisms are studied in detail. A scheme for the process of progressive utilization of oxidation energy by living beings is presented. The basic phenomena of photochemistry are presented, and some data available on vision are indicated. The principal aspects of photosynthesis are briefly reviewed. The general aspects of enzymatic action are studied. The elements of formal kinetics and the actual concepts on the activation energy of molecules are summarized. Only the simple enzyme kinetics are considered because more complex cases are based on the same principles. Some indications are given on the study of the action mechanism of enzymes. Isotopes whose properties permit their utilization as tracers in biochemistry are discussed. (tr-auth)

50697 COEFFICIENTS OF ACCUMULATION OF THE RADIOISOTOPE ^{59}Fe BY CERTAIN SPECIES OF FRESH WATER PLANTS. Matulyavichene, N. I. (Inst. of Botany, Vilnyus, USSR). Radiobiologiya; 10: 461-3(May-Jun 1970). (In Russian).

Data are presented on the ability of certain representative fresh water plants to accumulate the radioisotope iron-59 from water. Iron-59 accumulation coefficients for the plants investigated are compared for various experimental conditions. (JPRS) (TSS)

50698 COMPARATIVE UPTAKE OF ^{230}Th, ^{226}Ra, ^{210}Pb, AND ^{210}Po BY PLANTS. D'Souza, T. J.; Mistry, K. B. (Bhabha Atomic Research Center, Bombay). Radiat. Bot.; 10: 293-6 (Jun 1970).

Quantitative data are reported on the entry and translocation of ^{230}Th, ^{226}Ra, ^{210}Pb, and ^{210}Po measured under closely comparable conditions in nutrient culture experiments; ^{89}Sr was included for comparison. It is shown that the accumulation of ^{230}Th, ^{210}Pb, and ^{210}Po occurs predominantly in the roots and only very small amounts of these nuclides are translocated to shoots. Over comparable periods, the accumulation of ^{226}Ra in roots is 2 to 3 times lower than that of other nuclides of the uranium series. The most significant difference between ^{226}Ra and other nuclides is that the upward transport for radium is 50 to 200 times greater and the amount of radium translocated to shoots is comparable to that of strontium. (UK)

50699 CLINICAL VARIANTS OF NERVOUS SYSTEM RADIATION INJURIES FOLLOWING INCORPORATION OF SHORT-LIVED RADIOACTIVE SUBSTANCES. Ulitovskii, D. A. Vop. Psikhiat. Nevropatol.; 13: 623-30(1968). (In Russian).

The syndromes due to the effect of three widely used radioisotopes, ^{131}I, ^{32}P and ^{198}Au, on the nervous system were examined. The results revealed that effects of the three isotopes, incorporated in the form of NaI, Na_2HPO_4 and colloidal gold solution, respectively, are quite specific and differ markedly from the clinical signs observed in case of external irradiation. Incorporation of ^{131}I causes selective injury to the thyroid gland, followed by multiple neuritis and neurological syndromes of general radiation sickness. Incorporation of ^{32}P causes successively temporary cerebral circulatory injury, multiple bone osseous neuritis, chronic anemia of the bone marrow and ultimately localized injuries to the central nervous system, such as bleeding, and general radiation sickness. Intraperitoneal introduction of ^{198}Au causes trophic changes in the soft tissues, abdominal multiple neuritis, severe degeneration of the nerves, collapse and general worsening; in severe cases, neurological syndromes of radiation sickness, such as suppression of hemopoiesis, are observed. (TTT)

50700 IN VIVO ASSAY OF THYROID ^{131}I ACTIVITY IN THE RAT. Skala, L.; Petrasek, R. (Inst. of Human Nutrition, Prague). Physiol. Bohemoslov.; 18: 439-42(1969).

A method was elaborated for the assay of ^{131}I activity in the thyroid gland of rats in vivo. The estimation is made by means of a collimated scintillation counter focused on the thyroid area by means of a simple focusing device. A close correlation was found between the assay in vivo and in vitro (in a well-type crystal). The proportion of accumulated activity in the submaxillary gland 18 to 20 hours following isotope administration is negligible and thus does not bias the in vivo assay. The method is valuable in that it renders repeated assays of the thyroid radioactivity in the same animal possible. (auth)

50701 KINETICS OF ACCUMULATION AND REMOVAL OF RADIOACTIVE SULFUR FROM THE EYE TISSUES OF EXPERIMENTAL ANIMALS. Medvedovskaya, Ts. P. (Inst. of Industrial Hygiene and Occupational Diseases, Kiev). Oftal'mol. Zh.; No. 8, 612-14(1969). (In Russian).

Radioactive sulfur in the form of sodium sulfate (780 microcuries per kg of body weight) was injected subcutaneously into 12 rabbits. About 0.02 percent of this amount entered the eyeball. The largest quantity was found within one hour of injection in all eye tissues except the cornea and lens, where the accumulation stage lasted about three days. The highest concentration of the isotope an hour after the start of the experiment was in the sclera-vascular-retina complex, about 0.015 percent (i.e., more than 70 percent of the total amount of the isotope entering the eyeball). The smallest amount at this time was in the crystalline lens, but the relationship of the accumulated activities changed thereafter. Whereas the amount in the lens at the beginning was about 1 percent of the content in the eyeball, after three days it increased to about 14 percent; after 5 days, to about 22 to 36 percent of the total remaining activity in the eyeball. It was found that about 26 percent of the isotope was removed from the eyeball with T_{eff} close to 14 days. (JPRS)

50702 REUTILIZATION OF ^{131}I-5-IODO-2'-DEOXYURIDINE AS COMPARED TO ^{3}H-THYMIDINE IN MOUSE DUODENUM AND MAMMARY TUMOR. Dethlefsen, Lyle A. (Univ. of Pennsylvania, Philadelphia). J. Nat. Cancer Inst.; 44: 827-40(Apr 1970).

The relative utilization and reutilization of tritiated thymidine (^{3}H-TDR) and 5-iodo-2'-deoxyuridine (^{131}I-IUDR) were studied in the duodenum and mammary tumor of C3H mice. Both radiotracers were injected into the same tumor-bearing mice, and then the specific activity of the tissue DNA was measured at various times post injection. Relative reutilization was estimated by a comparison of the rates of loss (half-times) of the two radioisotopes. In the duodenum, the absolute reutilization was estimated by a comparison of half-time for the loss of each radioisotope with the generation time of the crypt cells. TDR was incorporated into the DNA of both tissues three times more extensively than IUDR. TDR was appreciably reutilized in the duodenum and probably in the tumors. Minimal IUDR reutilization was indicated in the duodenum, but there was no evidence of IUDR reutilization in the tumors. Exogenous TDR was administered in the drinking water in an attempt to modify reutilization of ^{3}H-TDR and ^{131}I-IUDR. Very large doses (20 μmole/ml) may have had some small effect on IUDR, but one must be concerned with secondary effects at this level, since 40 μmole/ml did produce clinical evidence of host toxicity. Thus these data show that IUDR is favored over TDR for experiments where reutilization may be a problem, but unfortunately, one cannot rule out the possibility of low levels of IUDR reutilization. (auth)

50703 METABOLISM OF METHIONINE-^{35}S AND SELENOMETHIONINE-^{75}Se IN RATS. Kovacs, Valeria. Stud. Cercet. Biochim.; 12: 367-72(1969). (In Rumanian).

Methionine-^{35}S and selenomethionine-^{75}Se were given simultaneously intraperitoneally to rats. At 24 hr after the administration, ^{75}Se showed a higher concentration than did ^{35}S in the liver, spleen, and kidney; in the urine, the concentration of ^{35}S-labeled metabolites was higher than that of ^{75}Se-labeled metabolites. (Selenium-Tellurium Abstr.)

50704 METABOLISM OF ACTINIUM IN THE RAT. Taylor, D. M. (Inst. of Cancer Research, Sutton, Eng.). Health Phys.; 19: 411-18(Sep 1970).

The distribution and retention of ^{227}Ac in rat tissues were studied after intravenous injection of the nuclide, in equilibrium with its daughters, as a complex with serum proteins, as nitrate, citrate or DTPA complex. When ^{227}Ac was administered as a serum protein complex, about 40% of the injected dose was excreted within 28 days and the remainder was lost with a half time of about 700 days. Except when complexed with DTPA, the tissue distribution of ^{227}Ac was not markedly influenced by the chemical form of the injected material. Treatment with DTPA or TTHA caused a 60% reduction in the body burden of ^{227}Ac, but only when treatment was started within 30 min of exposure. Studies of the distribution of ^{227}Ac amongst the serum proteins suggest that transferrin may be one of the proteins concerned in the transport of actinium in the

blood. Subcellular fractionation of liver showed that ^{227}Ac is associated with the lysosomes at 4 days after injection. (auth) (UK)

Radiation Effects

Refer also to abstracts 50757, 50924, 51048, 51064, 51065, 51083, 51111, and 51123.

50705 (AEC-tr-7171) RADIOBIOLOGY. Translation of Radiobiologiya; 10: 163-320(1970). 238p. Dep. NTIS.

Abstracts of 14 of the 15 articles in this translation were prepared from the original language edition of the journal. These abstracts appeared previously in Vol 24 issue 19 of NSA under the following abstract numbers: 39429-39431, 39473, 39481, 39509, 39520-39523, 39545, 39557, 39590, and 39592. The article for which an abstract was not included was not within the scope of NSA. (E.R.B.)

50706 (CEA-R-3978) STUDY OF POSSIBLE CHANGES BROUGHT ABOUT BY PLUTONIUM OXIDE IN THE PHOSPHATASIC ACID ACTIVITY OF ALVEOLAR MACROPHAGES OF THE RABBIT. Rouvroy, Huguette (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Jun 1970. 96p. (In French). Dep. CFSTI (U. S. Sales Only).

The various techniques used for determining the acid phosphatase activity of alveolar rabbit macrophages after inhalation of radioactive plutonium oxide particles, exposure of the animals, removal and sampling of the alveolar cells, and technical analysis are described. The results obtained are presented; they do not make it possible, in this particular case, to affirm that an important change in the enzymatic activity studied occurs. (auth) (France)

50707 (COO-1747-3) X-RAY INDUCED SYNTHESIS OF DNA IN POLYTENE CHROMOSOMES. Technical Progress Report. Plaut, W.; Valencia, Juan I. (Wisconsin Univ., Madison. Dept. of Zoology). Aug 1970. Contract AT(11-1)-1747. 3p. Dep. CFSTI.

Studies on the effects of inhibitors of RNA, DNA, and protein synthesis on X-ray induced incorporation of ^{3}H-thymidine or repair synthesis were extended. A series of experiments with uv light, which in almost all respects parallels the results obtained with X rays were started. In studies on temporal autonomy of DNA replication, two additional rearrangements and some additional repeats in the X chromosome were examined. Incidental to some of the uv studies, in which BUdR was allowed to be incorporated into the DNA of the polytene chromosomes, modifications were observed in the pattern of incorporation of ^{3}H-thymidine in the whole genome. (auth)

50708 (STI/PUB-243) RADIATION SENSITIVITY OF TOXINS AND ANIMAL POISONS. Panel Proceedings Series. Proceedings of a Panel held in Bangkok, 19-22 May 1969. (International Atomic Energy Agency, Vienna (Austria)). May 1970. 120p. (CONF-690555). IAEA $4.00.

Separate abstracts were prepared for 9 of the 11 papers appearing in the symposium. The other papers discuss structure-action relationships and immunochemical studies on cobra venom and the detoxification of cobra venom and bacterial toxins for biological production. (E.R.B.)

For abstracts of individual papers see: 50669 and 50722-50729.

50709 (UCLA-12-789) FREE RADICAL DAMAGE OF NUCLEIC ACIDS AND THEIR COMPONENTS BY IONIZING RADIATION. Myers, L. S. Jr. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). [1970]. Contract AT(04-1)-GEN-12. 57p. Dep. CFSTI.

Nucleic acid free radicals are important intermediates in a chain of events leading from deposition of energy by ionizing radiation to appearance of the biological effects of radiation. They are formed by deposition of energy directly within the nucleic acid, and by reactions of nucleic acids with hydrogen atoms, hydroxyl free radicals, and hydrated electrons produced by deposition of energy in water. On irradiation of pure nucleic acids, different radical species are formed under different conditions. Temperature, base composition, moisture content, protein contamination, and possibly secondary structure appear to be important parameters. The 5,6-dihydrothymin-5-yl radical is present in many irradiated DNA samples. Hydrogen atoms and hydroxyl free radicals add to the base and abstract hydrogen from the pentose moieties of nucleic acids to give free radicals localized on the moiety attacked. The yields of base radicals are approximately proportional to the relative amounts of each base in the nucleic acid. Radicals formed by nucleic acid constituents undergo rapid secondary reactions with oxygen and certain other small molecules. Proposed chemical mechanisms for the sensitization of nucleic acids to radiation by 5-bromouracil and N-ethylmaleimide, and for protection by sulfhydryl compounds are discussed. (auth)

50710 (UCRL-19868) OBSERVATIONS BY HUMAN SUBJECTS ON RADIATION-INDUCED LIGHT FLASHES IN FAST-NEUTRON, X-RAY, AND POSITIVE-PION BEAMS. Tobias, C. A.; Budinger, T. F.; Lyman, J. T. (California Univ., Berkeley. Lawrence Radiation Lab.). Aug 1970. Contract W-7405-eng-48. 16p. Dep. CFSTI.

In order to examine the hypothesis that light flashes seen by astronauts on lunar missions are the result of primary cosmic particles, two human subjects were exposed to a fast-neutron beam (20 MeV to 640 MeV) at the Berkeley 184-inch cyclotron. Both subjects saw 25 to 50 discrete pinpoint bright momentary light flashes in response to a flux of 10^{4} neutrons cm^{-2} sec^{-1} (1 mrem dose). The star-like phosphene phenomenon in the neutron exposure is different from x-ray induced radiophosphenes and from electrically produced visual flashes. No visual phenomenon was noted on positive pi meson exposure at 200 neutrons cm^{-2} sec^{-1}. We believe that bright flashes seen by astronauts are from primary cosmic particles traversing the retina. The mechanism is probably ionization, although light from Cherenkov effect has not been ruled out. (auth)

50711 (YALE-2653-41) STUDIES ON THE EFFECTS OF RADIATIONS ON DNA. Progress Report, August 1, 1969-July 31, 1970. Hutchinson, Franklin (Yale Univ., New Haven, Conn. Dept. of Molecular Biophysics and Biochemistry). Contract AT-(30-1)-2653. 10p. Dep. CFSTI.

Reaction mechanisms involved in the production of double-strand breaks in DNA extracted from x-irradiated Bacillus subtilis were investigated. Emphasis was placed on the effects of sedimentation in both neutral and alkaline sucrose gradients on production of single and double strand breaks in DNA in cells incubated after irradiation but before lysis. Methods for electron microscopic studies of uv-irradiated DNA are described. The possible effect of bromouracil incorporation in DNA on genetic recombination in uv or x irradiated bacterial DNA was investigated. A mutant of B. subtilis that contained four-stranded DNA was found to be extremely sensitive to both uv and x radiations. (C.H.)

50712 ANALYSIS OF THE DNA-RNA COMPLEX OBTAINED FROM EMBRYONAL SEEDS IN A CESIUM CHLORIDE DENSITY GRADIENT SYSTEM UNDER STANDARD CONDITIONS AND AFTER IRRADIATION. Tokarskaya, V. I. (Inst. of Biological Physics, Pushchino-on-Oka, USSR). Dokl. Akad. Nauk SSSR; 191: 464-7(11 Mar 1970). (In Russian).

Intermediate DNA-RNA hybrids were found in cells and in vitro synthesis of RNA; they represent an intermediate level of the transmission of the genetic information. This natural complex was analyzed under standard conditions and after exposure to γ radiation by ultracentrifugation in a density gradient of cesium chloride. Dry pea (Pisum sativum) seeds were exposed to 20 kR of γ radiation from a ^{60}Co source. The centrifugation was carried out at 20 to 22°C for 48 to 50 hr at 39,000 rpm with an original solution density of $\rho = 1.7040$. It was noted that the matrix-active DNA molecules from embryonal seeds have higher density than the molecules not involved in RNA synthesis. Appearance after irradiation in the area of the movement of the hybrid complex of several peaks of radioactivity in the high-density gradient regions of cesium chloride indicates that under the influence of radiation, new cistrons are activated for the synthesis; under the standard conditions, they were in a repressed state. (TTT)

50713 DYNAMICS OF NUCLEIC ACID CONTENT IN VARIOUS ORGANS IN RATS EXPOSED TO X RADIATION AND SODIUM GALLATE. Baraboi, V. A.; Zagoruiko, L. I.; Krechetova, A. D.; Matsui, S. P. (Kiev Inst. of Physiology). Fiziol. Zh., Akad. Nauk Ukr. RSR; 16: 385-92(May-Jun 1970). (In Ukrainian).

Radiation effects on DNA and RNA content in the spleen, small intestine mucus, and liver after total-body exposure to x irradiation (25.4 and 43R/min) of 580 rats injected with sodium gallate before and after irradiation were studied. Data obtained showed that the treatment with sodium gallate did not influence the initial radioinduced reduction of the level of the nucleic acid but inhibited, significantly, the restoration of the nucleic acid content following 7 to 13 days after the exposure. The observed influence of sodium gallates on the content of nucleic acids in the organs of rats was correlated with the survival of lethally irradiated animals. (R.V.J.)

50714 CHANGES IN CARDIAC GLYCOSIDES INDUCED BY ^{60}Co GAMMA RADIATIONS. Cospito, M.; Contarini, M.; Gangemi, G. (Istituto Chimico Farmaceutico Militare, Florence). Boll. Chim. Farm.; 108: 265-9(1969). (In Italian).

Some cardiac glucosides were irradiated with γ-rays from a 150 Ci ^{60}Co source. These substances consist of glycosidic steroids to which the active groups such as K-strophantine, digitosine, or ouabaine are attached. Before irradiation these substances were dissolved in double distilled water at a concentration of 0.25 mg/ml and the solution analysed spectroscopically and photometrically. The analysis was repeated after irradiation. The applied doses, measured with an $FeSO_4$-dosimeter, were 6,000, 16,500, 33,250, 44,500, 60,200, and 87,500 rad. The results of the irradiation can be summarized as follows: Alterations in lattice bonds, when irradiated in water or physiological solution, consist of a reduced activity corresponding to the applied dose. Reductions from 30 to 50% were observed at doses from 60,000 to 80,000 rad. It is a remarkable and not yet explained fact that the addition of small amounts of ethyl alcohol to the solution protects the glucosides to a great extent from irradiation changes so that at doses as high as 100,000 rad no appreciable reduction of activity could be detected. (F.J.W.)

50715 RELATIONS BETWEEN THE LASER-INDUCED OXIDATIONS OF THE HIGH AND LOW POTENTIAL CYTOCHROMES OF CHROMATIUM D. Seibert, Michael; Devault, Don (Univ. of Pennsylvania, Philadelphia). Biochim. Biophys. Acta; 205: 220-31(1970).

A single 30-nsec laser flash will oxidize only a limited amount of cytochrome in Chromatium D. The cytochrome oxidized will be C553 in dark, anaerobic whole cells and chromatophores or C555 in illuminated, anaerobic whole cells, in aerobic whole cells, and in illuminated chromatophores. This evidence indicates that the electron or energy transport component whose pool-size provides the limitation stated in the first sentence is common to the electron paths associated with both cytochromes unless a switching mechanism turns one off when the other is on. The quantum efficiency for C553 oxidation is close to one. The ratio of maximum amount of cytochrome oxidation in a single flash to quantum efficiency is the same for C555 as for C553. This means that both cytochromes are oxidized by centers served by the same light-gathering bacteriochlorophyll and suggests that their quantum efficiencies are equal. Oxidation half-times for the dark and illuminated laser-induced cytochromes are I μsec and 2 to 3 μsec, respectively; reduction half-times were >10 sec and 8 msec (34 msec in chromatophores), respectively. Assuming that the laser oxidizes equal amounts of the two cytochromes, the following in vivo, reduced-minus-oxidized ϵ_{mM}'s were obtained for C555:48 at 423 nm and 8.7 at 556 nm. The size of the photosynthetic unit was estimated at 140 to 160 bacteriochlorophyll molecules per cytochrome oxidized by a 30-nsec flash (whole cells). (auth)

50716 END GROUP DETERMINATION IN γ-IRRADIATED DNA. Bopp, Annemarie; Hagen, Ulrich (Kernforschungszentrum, Karlsruhe, Ger.). Biochim. Biophys. Acta; 209: 320-6 (1970).

Calf thymus DNA was irradiated in dilute solution with ^{60}Co γ rays. The number of single-strand breaks was determined by sedimentation analysis. In comparison the frequency of 5'-OH end groups was measured by specific phosphorylation with polynucleotide kinase. By applying this method to DNA before and after incubation with phosphomonoesterase, the frequency of 5'-phosphate groups besides the 5'-OH groups were obtained. The radioinduced single breaks amount to about 90% 5'-phosphate end groups. The number of breaks and simultaneously the number of 5'-phosphate groups rise after alkaline treatment of irradiated DNA (30 min 1 N NH_4OH) by a factor of about 1.5. The mechanism of chemical reactions leading to the single-strand break in DNA is discussed. (auth)

50717 ACTION OF ULTRAVIOLET RAYS ON NUCLEIC ACIDS AND THEIR CONSTITUENTS. Cruceanu, A. Stud. Cercet. Inframicrobiol.; 20: 217-38(1969). (In Rumanian).

The effect of uv radiation on the structure of nucleic acids is reviewed. The conclusions indicate that exposure to uv radiation results in the destruction of bacteria and viruses; it produces chromosome anomalies and mutations and interferes with cell division processes. Most of the effects observed are due to changes in nucleic acids. Studies on the correlation between wavelength and the action spectrum of uv radiation indicated that the strongest changes are induced with radiations having a wavelength of 260 mμ, corresponding to the absorption range of nucleic acids. The literature data on the uv irradiation of purine derivatives, pyrimidine, thymine, uracyl and various mixtures of nucleotides and oligonucleotides were examined, indicating the probable photochemical, hydration and dimerization mechanisms. Irradiation of RNA and DNA is studied in greater detail. (TTT)

50718 LATE LESIONS OF LUNGS OF RATS FOLLOWING WHOLE-BODY IRRADIATION. I. HISTOCHEMICAL OBSERVATIONS. Caulet, T.; Adnet, J. J.; Phuot, M.; Legeay, G. (Laboratoire d'Anatomie Pathologique, Reims, France). Pathol. Eur.; 5: 164-78(1970). (In French).

The histological and histochemical changes observed in the lungs of rats following single whole-body exposures in the range of 100 to 800 rad were described. The animals were examined from 2 to 13 months after exposure. Following 500–600 rad exposure, an interstitial fibrosis of collagenous type developed. Late injuries were very severe after 6 to 12 months; at the same time enzymatic changes were observed in the lung parenchyma, especially an increase of acid phosphatases, and a decrease of alkaline phosphatases except at the level of interalveolar capillary vessels. Cells with phospholipid inclusions (granulous pneumocytes) were often greatly altered (degranulation). Whole irradiation of the lungs of rats with a superadded injury, exogenous overstress, resulted in a somewhat different change of sclero-emphysemous type. (auth)

50719 LATE LESIONS OF LUNGS OF RATS FOLLOWING WHOLE-BODY IRRADIATION. II. MORPHOLOGICAL AND CYTOLOGICAL STUDIES ON THE ELECTRON MICROSCOPE. Adnet, J. J.; Caulet, T.; Legeay, G.; Hopfner, C.; Guenet, J. L. Pathol. Eur.; 5: 179-97(1970). (In French).

Morphological and cytochemical changes of the ultrastructure of rat lungs were observed following single whole-body exposures in the range of 100 to 800 rad. Samples were taken after a delay of 8 weeks to 11 months. The lungs were compared with those of same age non-irradiated rats. A number of rats were injected blood intratracheally. Interstitial fibroses developing progressively were observed; when the rats received blood injections the sclerosis was different, showing typical aspects of sclero-emphysema. The enzymatic changes of the elements constituting the lung parenchyma were studied; the most interesting concerned the acid phosphatases that could be detected in the granulous pneumocytes. Acid phosphatases were found only in the lamellar figures of the macrophagic elements. The positivity of alkaline phosphatase on the vascular walls at doses above 600 rad indicated important changes in the vascularization of sclerous areas. Enzyme detection and a study by 3H-glycine allowed to insist on the two types of lamellar figures found in the cells of the alveolar lining. (auth)

50720 SOLVENT EFFECTS IN THE RADIATION DEGRADATION OF DNA SOLUTIONS. Blackman, Carl Frederick Jr. University Park, Pa.; Pennsylvania State Univ. (1969). 87p. University Microfilms Order No. 70-7183.
Thesis.

Calf Thymus DNA was prepared in three solvents and irradiated at 77°K for a series of doses and concentrations with cobalt 60 gamma rays. Alkali and neutral band sedimentation was used to obtain initial molecular weight distributions and the molecular weight of both single and double strand samples at each dose. This information was then converted to the number of molecular scissions per molecule by an equation for random scissions. The data were analyzed in terms of direct and indirect radiation effect and the results were compared with those of other workers. The damage to DNA irradiated at 77°K and warmed to room temperature for analysis was enhanced when phosphate was present; this enhancement was attributed, in part, to indirect radiation action. The rate of single strand break production, in terms of breaks per 10^8 daltons per megarad, was 0.9 in tris solvent, 1.1 in a modified SSCT solvent, and 5.2 in a phosphate solvent. Differences in these rates were attributed to solvent modifications of radiation action. The double strand break production could be interpreted as resulting from an accumulation of single strand breaks and from directly-produced double strand breaks which occurred when a sensitive core (approximately 3 Angstroms in diameter) is hit. (Diss. Abstr. Int., B)

50721 CONTENT OF AMMONIA AND GLUTAMINE IN X-IRRADIATED BRAIN WITH SHUT-OFF ADRENAL CORTEX. Pikulev, A. T.; Tal'kovskaya, L. S. Dokl. Akad. Nauk BSSR, 12: 1048-9(Nov 1968). (In Russian).

The content of ammonia and glutamine in brain tissue following general x irradiation at a dose of 40 R, 1, 2, and 3 days following ablation of the adrenal cortex with repeated injections of larger doses of hydrocortisone, was determined. Under these conditions, there occurred a significant increase in the quantity of ammonia at all times studied, particularly during the first hour and days after the action of ionizing radiation. The quantity of glutamine following x irradiation of rats, in which the function of the adrenal cortex was terminated, is reduced. Statistical treatment confirms the authenticity of changes toward the end of days one and two. It was concluded that upon x irradiation following pharmacological adrenalectomy, in comparison with the irradiation of intact animals, that there occurs not only quantitative shifts, but also qualitative changes in the parameters. (tr-auth)

50722 EFFECT OF RADIATION ON THE BIOLOGICAL PROPERTIES OF PROTEINS. Skalka, M.; Antoni, F. (International Atomic Energy Agency, Vienna). pp 1-11 of Radiation Sensitivity of Toxins and Animal Poisons. Vienna; International Atomic Energy Agency (1970).

From Panel on the Radiation Sensitivity of Toxins and Animal Poisons, Bangkok, Thailand. See STI/PUB-243; CONF-690555.

The irradiation of proteins in dry state or in solution leads to a number of chemical, physicochemical, and conformational changes of the proteins. These changes result in a decrease and loss of such biological properties as the enzymic, hormonal, toxic, and immunological functions of proteins. Some new results concerned with radiation damage to the biological function of proteins are reviewed and their significance to the study of radiation sensitivity of toxins and venoms is discussed. (auth)

50723 EFFECT OF ^{60}Co GAMMA IRRADIATION ON ANTIGEN–ANTIBODY SYSTEMS. Sundaram, K.; Sundaresan, P.; Phondke, G. P. (Bhabha Atomic Research Centre, Trombay, India). pp 13-18 of Radiation Sensitivity of Toxins and Animal Poisons. Vienna; International Atomic Energy Agency (1970).

From Panel on the Radiation Sensitivity of Toxins and Animal Poisons, Bangkok, Thailand. See STI/PUB-243; CONF-690555.

The effects of ^{60}Co γ rays on normal human serum and rabbit anti-normal human serum were studied. Polyacrylamide gel electrophoresis and immunodiffusion tests were performed for these samples. Irradiated normal human serum, in spite of a breakdown of its components, was able to form precipitin lines with the antiserum. However, when the antiserum was irradiated, its antigen binding capacity was reduced at a faster rate. A good correlation between the electrophoretic behavior and the antigen-antibody reaction of these serum proteins was obtained. In the light of these findings, the nature of radiation damage to the antigenic potentialities of proteins is discussed. (auth)

50724 TOXINS PRODUCED BY CL. BOTULINUM AND THEIR RADIOSENSITIVITY. Skulberg, A. (Norwegian Research Committee for Preservation of Agricultural Food Products, Oslo). pp 19-30 of Radiation Sensitivity of Toxins and Animal Poisons. Vienna; International Atomic Energy Agency (1970).

From Panel on the Radiation Sensitivity of Toxins and Animal Poisons, Bangkok, Thailand. See STI/PUB-243; CONF-690555.

A description is given of the mechanism of toxin formation by Cl. botulinum and the chemical nature of botulinal toxin. Attention is paid particularly to fragmentation of the toxin molecule, as this may be important for the inactivation mechanism by irradiation. Parameters of importance for the irradiation effect are discussed. The main factors are the substrate, temperature, and the degree of purity of the toxin preparations. Practical application of irradiation for inactivation of botulinal toxins in food is examined, paying particular attention to the kind of food and the irradiation conditions used in experiments of this type. Possibilities for combined treatments are reviewed. Finally, the use of irradiation as an instrument for studying fundamental properties of toxins of microbiological origin is discussed. (auth)

50725 RADIOSENSITIVITIES OF CL. BOTULINUM TYPE-E TOXINS. Sakaguchi, G. (National Inst. of Health, Tokyo). pp 31-40 of Radiation Sensitivity of Toxins and Animal Poisons. Vienna; International Atomic Energy Agency (1970).

From Panel on the Radiation Sensitivity of Toxins and Animal Poisons, Bangkok, Thailand. See STI/PUB-243; CONF-690555.

Purified preparations of Clostridium botulinum type-E toxin are highly sensitive to γ irradiation in an aqueous phase. Tryptic activation of prototoxin does not change its radiosensitivity. Proteins, nucleic acids, and certain amino acids and purines protect type-E toxin from radiolysis. Such protection may explain the high resistance of botulinum toxin and probably other bacterial toxins in foods. Probably owing to the unavailability of simple and accurate assay methods, only a little work on the radiosensitivities of bacterial toxins has been made. We established a rapid bioassay method for titrating toxicity of trypsin-activated type-E toxins by intravenous injection into mice and determining the time from injection to death, and also a highly sensitive hemagglutination inhibition method to test for the individual antigenicities of the Eα and Eβ components comprising 12S toxins. By the use of both methods, the effect of γ irradiation upon toxicities and antigenicities of different forms of type-E toxins and their components in an aqueous phase was investigated. The antigenicities were much more resistant to irradiation than were the toxicities. The Eα component in the free and the bound forms showed a similar sensitivity in terms of both toxicity and antigenicity; Eβ in the two forms also showed a similar sensitivity in terms of antigenicity. The possibility of preparing an effective toxoid in a short time by a combination of formalinization and γ irradiation was discussed. (auth)

50726 AFLATOXIN AND ITS RADIOSENSITIVITY. Aibara, K.; Miyaki, K. (National Inst. of Health, Tokyo). pp 41-62 of Radiation Sensitivity of Toxins and Animal Poisons. Vienna; International Atomic Energy Agency (1970).

From Panel on the Radiation Sensitivity of Toxins and Animal Poisons, Bangkok, Thailand. See STI/PUB-243; CONF-690555.

A review of aflatoxin, giving numerous references from the literature on production, chemical nature, physical properties, biological effects, carcinogenic properties, aflatoxin M and analytical methods is presented. Recent studies on the effects of radiation, γ rays or uv rays, on aflatoxin B_1 are presented. The destruction rate of aflatoxin B_1 in liquid state by γ radiation varied depending on the concentration of aflatoxin B_1, the higher the concentration, the lower the destruction rate. The biological effect of aflatoxin B_1, when it was determined by a chicken embryo test, seemed to be decreased by about half of the original after γ radiation with 4.0×10^4 rad in water and 9.0×10^3 rad in EtOH. In a dry state, approximately 10% of aflatoxin was destroyed by an irradiation of 18.2 Mrad. Destruction experiments by uv radiation were also performed with aflatoxin B_1 solutions in MeOH, EtOH, benzene, chloroform or water at a concentration of 10 μg/ml. The destruction by uv radiation with doses smaller than a certain limit proceeded by the first-order reaction. Further studies are now in progress to confirm this point. Two of the irradiation products were separated by column chromatography from MeOH solution. One has yellow-green fluorescence with R_f value of 0.84 and the other has blue fluorescence with R_f value 0.5 on a thin-layer chromato-plate under a long-wave u.v.-light. When these two substances were fragmented by electron impact, a marked intensive peak at m/e 149 appeared. (auth)

50727 PROBLEMS ENCOUNTERED IN THE PRODUCTION OF A POTENT ANTIVENIN. Flowers, H. H. (Dept. of the Army, San Francisco). pp 95-8 of Radiation Sensitivity of Toxins and Animal Poisons. Vienna; International Atomic Energy Agency (1970).

From Panel on the Radiation Sensitivity of Toxins and Animal Poisons, Bangkok, Thailand. See STI/PUB-243; CONF-690555.

Specific antivenins have proven to be the favored drug for the treatment of snake envenomation. Because of their toxicity, most venoms must be toxoided before they may be injected into experimental animals. Many methods have been employed in an effort to reduce local reactivity and lethality of the venom without altering its antigenic character. Among the most common are EDTA, DHTA, formalin, and x radiation. Though toxicity is definitely reduced, laboratory animals still have a mortality rate of 25 to 30%. Recent successes in the isolation of specific venom toxins have offered a new approach to the toxoiding of venoms and the subsequent production of more potent antivenins. (auth)

50728 RADIATION EFFECTS ON NAJA NAJA VENOM AND POLYVALENT ANTISERA. Sundaram, K.; Philip, J.; Bhatt, M. B. (Bhabha Atomic Research Centre, Trombay, India). pp 99-106 of Radiation Sensitivity of Toxins and Animal Poisons. Vienna; International Atomic Energy Agency (1970).

From Panel on the Radiation Sensitivity of Toxins and Animal Poisons, Bangkok, Thailand. See STI/PUB-243; CONF-690555.

The results of investigations on the lethal effects of Naja Naja venom following exposure to γ radiation are presented. Though no gross damage to molecular structure of the heterogeneous components in the venom is evident in uv absorption studies, biological tests of lethality, rennin-like activity, and anti-coagulation effect show a significant reduction. The effect of irradiation on the antivenin indicates that the inactivation measured in terms of mouse protection units is not linear and at the maximum of the exposure studied (2.5 Mrad), the inactivation is only about 40% of the non-irradiated control. The results of these studies are discussed. (auth)

50729 RADIATION EFFECTS ON COBRA VENOM. Lauhatirananda, P. (Queen Soavabha Memorial Inst., Bangkok); Ganthavorn, S.; Hayodom, V. pp 107-12 of Radiation Sensitivity of Toxins and Animal Poisons. Vienna; International Atomic Energy Agency (1970).

From Panel on the Radiation Sensitivity of Toxins and Animal Poisons, Bangkok, Thailand. See STI/PUB-243; CONF-690555.

An investigation was made on the radiosensitivity of the toxic and immunological properties of Thailand cobra venoms. The source of radiation was a ^{60}Co unit delivering a dose-rate of 5600 rad/min. Samples were prepared from the pooled lyophilized venom. Most samples were irradiated in aqueous form at a concentration of 20 mg/ml. The radiation doses were 0, 0.5, 1, 2, 3, 4, and 5 Mrad. In addition, dry samples were also irradiated up to 60 Mrad for detoxification study. For aqueous samples, the results indicate that the antigenicity, as shown by immunodiffusion and immunoelectrophoresis, is destroyed proportionately with the

destruction of toxicity. Both seem to be destroyed completely at about 4 Mrad. An immunization test was also made using sheep as antivenin production animals, but it is too early to report this result. For a dry sample, the detoxification is not complete at a dose of 60 Mrad. (auth)

50730 ADENOSINE TRIPHOSPHATE CONTENT AND INTENSITY OF ITS RESYNTHESIS (BY ^{32}P INCORPORATION STUDIES) IN SEVERAL TISSUES OF IRRADIATED RATS. Voskoboinikov, G. V. (Central Research Inst. of Roentgenology and Radiology, Leningrad). Vop. Med. Khim.; 16: 343-8(Jul-Aug 1970). (In Russian).

The determination of ATP concentration and intensity of its resynthesis in liver, spleen, and testis of rats x irradiated at a dose 1,000 R was made. The ATP content in the liver of irradiated animals was at the normal level, or even increased, practically at all time intervals studied. Only 13 hr after irradiation a slight drop in ATP concentration was noted. In the spleen of experimental animals ATP content was within the limits of control values at least during two days of the experiment despite the sharp drop in weight of the organ during the first several hours postirradiation. The significant decrease in ATP content was noticed only at the moment of death of the rats. No changes in ATP content was found in testis at all time intervals studied. The intensification of metabolic processes during the preparation of cell to mitosis at the experimental conditions did not reveal any disorders in energy generating systems in regenerating rat liver. The absence of significant changes in ATP concentration after irradiation and in the rate of its terminal phosphate exchange in radioresistant (liver) as well as radiosensitive tissues (spleen, testis) gives the base for the assumption that the energy potential of irradiated tissues remains well balanced. (auth)

50731 EFFECT OF IONIZING RADIATION ON ^{14}C-AMINO ACIDS INCORPORATION INTO NUCLEAR PROTEINS AND DNP OF RAT TISSUE CELLS. Nikolskii, A. V.; Blokhina, V. D.; Romantsev, E. F. Vop. Med. Khim.; 16: 259-62(May-Jun 1970). (In Russian).

Carbon-14-labeled amino acid incorporation in vitro into total nuclear proteins and DNP of liver, spleen, and thymus of rats irradiated at a dose of 1000 R was studied. The protein-synthetizing system of DNP was the nuclear residue that did not contain globulins. One and 24 hr after the irradiation the pronounced inhibition of ^{14}C amino acids incorporation into nuclei and DNP of thymus cells was noted. Twenty-four hr after the irradiation the same picture took place in the spleen. On the other hand, 1 hr after the irradiation either the stimulation or the inhibition, depending upon the season, was shown. In the liver, at all time-intervals studied, some activation in label incorporation was observed. (auth)

50732 SOME PECULIARITIES OF THE CHANGE IN THE CONCENTRATION OF FREE RADICALS DURING THE DEVELOPMENT OF RADIATION SICKNESS. Kovalenko, O. A.; Chibrikin, V. M.; Emanuel, N. M. (Inst. of Chemical Physics, Moscow). Radiobiologiya; 10: 355-8(May-Jun 1970). (In Russian).

Diurnal fluctuations of the free radical concentration in the liver and spleen of intact mice were detected. The kinetics of the change in the free radical concentration in the livers and spleens of irradiated non-inbred mice were studied. A correlation was found between the diurnal fluctuations of the free radical concentration in the normal state in the mouse spleen and the diurnal fluctuations of the percent death of the same animals after irradiation. (tr-auth)

50733 STUDY OF AEROBIC GLYCOLYSIS OF IRRADIATED RAT THYMOCYTES. Slozhenikina, L. V.; Kuzin, A. M. (Inst. of Biological Physics, Pushchino, USSR). Radiobiologiya; 10: 350-4(May-Jun 1970). (In Russian).

The effects of γ radiation doses of 1500 R on the anaerobic and aerobic glycolysis of isolated rat thymocytes were investigated. Stability of the anaerobic glycolysis of the thymocytes to the action of ionizing radiation was detected. Aerobic glycolysis was intensified in rat thymocytes irradiated in vitro and in vivo when glucose was used as the exogenous substrate; this effect was not evident when fructose-1, 6-diphosphate was the substrate. It is concluded that radiation disturbs the regulatory mechanisms of glycolysis before the formation of fructose-1, 6-diphosphate, possibly at the level of phosphofructokinase and hexokinase. (tr-auth)

50734 ACTIVITY OF HYDROLYTIC ENZYMES OF THE SMALL INTESTINE IN THE EARLY PERIODS OF POSTNATAL LIFE IN PRENATALLY IRRADIATED RATS. Gavrilov, R. I.; Ovdeichuk, R. A.; Troichuk, D. F. (Central Scientific Research Roentgenoradiological Inst., Leningrad). Radiobiologiya; 10: 342-5(May-Jun 1970). (In Russian).

Prenatal irradiation of rats during the period of functional differentiation of the small intestine increased the dipeptidase, β-galactosidase, and invertase activity in epithelial cells of the intestine during the early periods of postnatal life; this effect was especially significant in the critical period of ontogenesis when milk nutrition changes to a definitive type of nutrition. (tr-auth)

50735 REDUCTION OF THE YIELD OF DNA DURING DEPROTEINIZATION OF UV- OR GAMMA-IRRADIATED SOLUTIONS OF DEOXYRIBONUCLEOPROTEINS. II. SOME PROBLEMS OF THE FORMATION OF DAMAGE. Sklobovskaya, M. V.; Ryabchenko, N. I. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya; 10: 332-7(May-Jun 1970). (In Russian).

The conditions of formation of a strengthened bond between the components of the nucleoprotein complex, arising during uv and γ irradiation of solutions of DNP and artificial DNA-histone complexes are discussed. It was shown that in the case of irradiation at the doses used, no more than 3 to 4% of the protein component of DNP enters into a strengthened bond with DNA. The probability of the formation of this bond depends on the degree of damage to the DNA and on the amount of protein in the complex. (tr-auth)

50736 STUDY OF THE ROLE OF LYMPHOID TISSUE IN THE POST-RADIATION HYPEREXCRETION OF DEOXYCYTIDINE, DEOXYURIDINE, AND THYMIDINE WITH SPECIFIC ANTISERUM. Mazurik, V. K.; Bryksina, L. E.; Saprygin, D. B.; Yarilin, A. A. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya; 10: 346-9(May-Jun 1970). (In Russian).

The role of lymphoid tissue in the postradiation deoxynucleosiduria was determined; preliminary breakdown of the blood and thymus lymphocytes with antilymphocyte serum halved the post-radiation hyperexcretion of deoxycytidine and thymidine. Although the role of the spleen in deoxynucleosiduria is great, it does not predominate. Since hyperexcretion is partially simulated by the injection of foreign sera, it is not a specific index of radiation damage. (tr-auth)

50737 INFLUENCE OF RADIATION DAMAGE ON THE THROMBOPLASTIC ACTIVITY OF THE TISSUES. Zubairov, D. M.; Gritsuk, G. N.; Vladimirova, L. F.; Anisimova, V. F. (Kazan Medical Inst.). Radiobiologiya; 10: 432-4(May-Jun 1970). (In Russian).

At the height of radiation sickness, the thromboplastic activity in the vascular wall and red bone marrow of rabbits is accompanied by a decrease in phosphatidylethanolamine and phosphatidylserine contents. Thromboplastic and proteolytic activities were unrelated in extracts of the brain, spleen, and red bone marrow of both healthy or irradiated animals. (tr-auth)

50738 SENSITIVITY OF IRRADIATED DNA OF VARIOUS BACTERIAL PHAGES (T4, T7, λ, AND B3) TO HYDRODYNAMIC SHEAR. Strazhevskaya, N. B.; Struchkov, V. A. (Inst. of Biological Physics, Puschino, USSR). Radiobiologiya; 10: 429-31 (May-Jun 1970). (In Russian).

The sensitivity of irradiated solutions of phage (T4r, T7, λ, and B3) DNA to hydrodynamic shear was investigated. Hydrodynamic shear of irradiated DNA solutions (1 kR) resulted in substantial degradation, the magnitude of which was dependent upon the molecular weight of the DNA. The significance of hydrodynamic factor in radiobiological evaluation of double and single breaks in DNA is emphasized. (JPRS) (TSS)

50739 ISOENZYMES OF LDH IN THE DEVELOPING RAT BRAIN AFTER GAMMA IRRADIATION DURING THE PERIOD OF EMBRYOGENESIS. Kuzin, A. M.; Vygovskaya, G. P. (Moscow Tech. Inst. of Meat and Milk Industry). Radiobiologiya; 10: 338-41(May-Jun 1970). (In Russian).

Changes in the isoenzymes of LDH (Lactate dehydrogenase) and total LDH activity were investigated in the brains of infant rats after in utero exposure to γ radiation during organogenesis of the CNS on the 8 to 15th days of pregnancy. Irradiation on the 8th to 9th and 15th days of pregnancy did not cause any significant changes in the isoenzyme composition of LDH. Exposure on the 11th day caused a lag in the development of the H/M ratio in comparison to the norm; the lag resulted from a significant decrease in H_4 and H_3M_1. In the case of irradiation on the 13th day, the percent content of the isoenzymes M_4 and H_1M_3 was decreased and H_4 and H_3M_1 increased H/M. (JPRS) (TSS)

50740 COMPARATIVE RADIO SENSITIVITY OF THE MEMBRANES OF ISOLATED NUCLEI, ISOLATED FROM VARIOUS ORGANS AND TISSUES. Nadareishvili, K. Sh.; Kakhiani, E. D.; Dzhokhadze, D. I. (Inst. of Physiology, Tbilisi, USSR). Radiobiologiya; 10: 364-8(May-Jun 1970). (In Russian).

The kinetics of the osmotic decomposition were studied in nuclei

isolated from the spleen, liver, and kidney epithelium by homogenization prior to differential centrifuging in a sucrose gradient. Based on osmotic stability, isolated nuclei of liver cells, all types of lymphoid cells, epithelical cells of kidney tubules, and endothelial cells of the vessels did not vary in respect to radiosensitivity and produced coinciding dose-effect curves when irradiated in suspension. (JPRS) (TSS)

50741 NUCLEAR ACTIVITY. Hatfield, J. (Cambridge Univ., Eng.). Nature (London); 227: 101(4 Jul 1970).

Some errors in the report of the British Society for Cell Biology meeting on the control of nuclear activity (Nature 226: 406(1970)) are pointed out. The apparatus used in the experiments provided a microbeam of uv radiation, not x radiation as stated. These radiations can produce quite different biological effects. It was also implied that microbeam irradiation of the nucleolus or the nucleoplasm does not affect DNA synthesis; on the contrary, at certain doses microbeam irradiation drastically reduces DNA synthesis. The results show that nucleolus does not appear to specifically control the onset of DNA synthesis. (UK)

50742 RECOVERY OF HAEMOPHILUS INFLUENZAE FROM ULTRAVIOLET AND X-RAY DAMAGE. Barnhart, B. J.; Cox, S. H. (Los Alamos Scientific Lab., N. Mex.). Photochem. Photobiol.; 11: 147-62(1970).

Results of experiments on reactivation of uv-irradiated Hemophilus influenzae and cellular reactivation of uv-damaged transforming deoxyribonucleic acid (DNA) and bacteriophage are reported. Liquid-holding recovery (LHR) is small for the uv-sensitive mutant BC100 which, relative to the wild type, also has greatly reduced host-cell reactivation (HCR) of uv-inactivated phage, and competent cultures show reduced competent cell reactivation (CCR) of uv-inactivated transforming DNA. BC100 cells can be transformed with DNA isolated from the wild type strain Rd to a uv-resistance similar to that of Rd, and irradiation of the DNA reduces the transformation frequency for this marker (uvr). The uv-resistant mutant BC200 displays very little LHR under the usual conditions where reactivation occurs after plating. The colony-forming ability (cfa) of irradiated BC200 is greater than that of Rd, but HCR and CCR are the same on this mutant as on the wild type. The major difference between Rd and BC200 is the enhanced uv survival of cfa of the latter. It was determined that this difference reflects cell lysis of irradiated Rd and lack of lysis in BC200 cultures. That lysis is closely correlated with damage to the bacterial chromosome is suggested by the finding that the lytic response of Rd (as determined turbidimetrically) can be negated by the liquid-holding procedure, but lysis of BC100 (which lacks comparable DNA-repair ability) can be only partially inhibited by this procedure. LHR occurs when post-plating dark recovery is incomplete, is temperature-sensitive, and occurs unimpeded when post-uv protein synthesis is inhibited by chloramphenicol. It is suggested that enzymatically catalyzed reactivation of DNA occurs or is initiated during liquid-holding of uv-irradiated H. influenzae Rd and that the necessary enzyme(s) exists prior to appearance of uv lesions in the DNA. Results are reported for x ray inactivation of transforming DNA as assayed on BC100, Rd, and BC200, and of the cfa of the three strains. (auth) (UK)

50743 THE TEMPORAL COURSE OF RADIATION EFFECT ON GLYCINE TRANSPORT IN ASCITES TUMOR CELLS. Hagemann, Ronald F.; Evans, Titus C. (Univ. of Iowa, Iowa City). Int. J. Radiat. Biol.; 17: 401-5(1970).

Ehrlich ascites-tumor cells were irradiated with 3, 6, or 10 kR in vitro under conditions (concentrated cell suspension, relative hypoxia) in which no acute diminution of glycine transport occurred. The ability to transport glycine was found to decrease progressively as a function of time after irradiation, and was dependent on exposure. This effect of irradiation appears to involve the active transport system per se, since the data are not explicable on the basis of: (1) cell death, (2) alterations in population density, (3) increased passive membrane permeability to glycine, or (4) ageing to the cell population. (auth) (UK)

50744 RETENTION OF FUNCTIONAL CODING PROPERTIES BY POLYRIBOSOMES IN THE X-IRRADIATED MAMMALIAN CELL. Tobey, R. A.; Hutson, J. Y.; Walters, R. A.; Peterson, D. F. (Los Alamos Scientific Lab., N. Mex.). Int. J. Radiat. Biol.; 17: 487-92(1970).

By x irradiation of cultured Chinese hamster cells infected with Mengovirus, at different times after infection, and determination of the time-course and extent of the production of virus specific polyribosomes, studies were made of the capacity of polyribosomes to survive irradiation and subsequently maintain functional protein synthesis. Dose rates were from 50 to 2400 rads/min. In cultures infected subsequent to irradiation, there was only slight reduction in yield of virus, but the yield decreased with increasing dose in cultures irradiated after infection. The results suggested that the lesion was not within the components of the protein synthetic machinery or in the ability of stable messengers present during irradiation to continue synthesizing functional proteins during the recovery period. (UK)

50745 POSSIBILITY OF NONTHERMAL BIOLOGICAL EFFECTS OF PULSED ELECTROMAGNETIC RADIATION. Sher, Lawrence D.; Kresch, Edward; Schwan, Herman P. (Univ. of Pennsylvania, Philadelphia). Biophys. J.; 10: 970-9(Oct 1970).

Two mechanisms for the interaction of alternating electrical fields with biological tissue are the development of heat, via i^2R losses, and field-induced force effects, via differences in passive electrical properties. It has been shown that for continuous wave (CW) fields in media of physiologic electrical conductivity, the development of heat (>1°C) always precedes the possible appearance of a field-induced force effect. Using pearl-chain formation as a model effect and experimentally demonstrating that its time constant varies inversely as the square of the electrical field strength, it was shown that a pulsed field had no greater ability than a CW field of equal rms field strength to produce a field-induced force effect. Thus, the statement above for CW fields can be broadened to include pulsed fields of any description. By relating incident power density to electric field strength in tissue, it was shown that the American National Standards Institute's radiation protection guide obviates the production of genetic effects in man, if they exist, via field-induced force effects. (auth)

50746 BIOCHEMISCH NACHWEISBARE STRAHLENWIRKUNGEN UND DEREN BEZIEHUNGEN ZUR STRAHLENTHERAPIE. Symposium der Arbeitsgemeinschaft fuer Strahlenbiologie in der Deutschen Roentgengesellschaft, Stuttgart 11. Mai 1969. (Biochemically Detectable Radiation Effects and Their Significance in Radiotherapy. Symposium of the Work Committee for Radiation Biology of the German Roentgen Society, Stuttgart, May 11, 1969). Gerber, Georg B.; Ladner, Hans-Adolf; Rausch, Ludwig; Streffer, Christian (eds.). Stuttgart; Georg Thieme Verlag (1970). 172p. DM 38,-. (CONF-690551).

Seventeen separate abstracts were prepared. For other information on conference see report number index. (H.B.G.)

For abstracts of individual papers see: 50656, 50747–50760, 51058, and 51059.

50747 METABOLITES OF NUCLEIC ACID IN EXPERIMENTAL RADIOBIOLOGY AND CLINICAL RADIOLOGY. Dienstbier, Z.; Zicha, B.; Buric, L. (Charles Univ., Prague). pp 23-39 of Biochemisch Nachweisbare Strahlenwirkungen und Deren Beziehungen zur Strahlentherapie. /Gerber, Georg B. (ed.). Stuttgart; Georg Thieme Verlag (1970). (In German).

From Conference on Society of Radiation Biology, Stuttgart, Germany. See CONF-690551.

Urinary excretion of β-aminoisobutyric acid, deoxycytidine, deoxyuridine, uracil, thymidine, and pseudouridine following radiation exposure is reviewed for animals and man. Seven tables and 60 references are given. (H.B.G.)

50748 DEOXYCYTIDINE AS BIOCHEMICAL INDICATOR OF RADIATION INJURY AND ITS DETERMINATION IN HUMAN URINE. Gerber, G. B.; Zicha, B.; Mathieu, O.; Remy-Defraigne, J.; Deroo, J. (EURATOM, Mol, Belg. CEEN, Mol, Belg.). pp 40-4 of Biochemisch Nachweisbare Strahlenwirkungen und Deren Beziehungen zur Strahlentherapie. /Gerber, Georg B. (ed.). Stuttgart; Georg Thieme Verlag (1970). (In German).

From Conference on Society of Radiation Biology, Stuttgart, Germany. See CONF-690551.

Increased urinary excretion of deoxycytidine is a sensitive and specific metabolic reaction to ionizing radiation. The method for its measurement in human urine is described and presented in four tables. The procedure requires a period from two to three days of which five hours are actual working time. Results are listed. (H.B.G.)

50749 AMINO ACIDS AND THEIR METABOLITES IN EXPERIMENTAL RADIOBIOLOGY AND CLINICAL RADIOLOGY. Streffer, C. (Univ., Freiburg i. B.). pp 51-64 of Biochemisch Nachweisbare Strahlenwirkungen und Deren Beziehungen zur Strahlentherapie. /Gerber, Georg B. (ed.). Stuttgart; Georg Thieme Verlag (1970). (In German).

From Conference on Society of Radiation Biology, Stuttgart, Germany. See CONF-690551.

Radiation effects on amino acid metabolism are surveyed and judged by urinary excretion. In the case of tryptophane metabolism, urinary excretion and determination in the liver agreed perfectly. For each individual amino acid such correlation between organ content and excretion must be determined experimentally. Two types of reactions are distinguished. A radiation

induced breakdown of tissue leads to an unspecific release of amino acids; a direct radiation effect on cell metabolism causes specific changes in amino acid excretion. (H.B.G.)

50750 AMINO ACIDS AND THEIR METABOLITES IN CLINICAL RADIOLOGY. Ladner, H.-A. (Univ., Mainz). pp 64-78 of Biochemisch Nachweisbare Strahlenwirkungen und Deren Beziehungen zur Strahlentherapie. /Gerber, Georg B. (ed.). Stuttgart; Georg Thieme Verlag (1970). (In German).
From Conference on Society of Radiation Biology, Stuttgart, Germany. See CONF-690551.

Following either whole-body or local irradiation, urinary excretion of certain amino acids is increased, and of others decreased. Some amino acids are secreted to a significantly higher degree in tumor patients, especially those with lymph node metastases; therefore, amino acids may serve as a diagnostic tool for staging tumor patients. Furthermore, the urinary amino acid pattern appears suitable for judging effectiveness and prognosis for radiotherapy. (H.B.G.)

50751 STUDIES ON FREE AMINO ACIDS IN THE CENTRAL NERVOUS SYSTEM FOLLOWING WHOLE-BODY GAMMA IRRADIATION. Egana, E. (Univ. de Chile, Santiago de Chile); Szirmai, E. pp 78-82 of Biochemisch Nachweisbare Strahlenwirkungen und Deren Beziehungen zur Strahlentherapie. /Gerber, Georg B. (ed.). Stuttgart; Georg Thieme Verlag (1970). (In German).
From Conference on Society of Radiation Biology, Stuttgart, Germany. See CONF-690551.

Rats were exposed to 60 R of whole-body ^{60}Co γ radiation. Following radiation, ^{14}C-labeled glucose was injected intraperitoneally into the irradiated animals and a nonirradiated control group. Subsequently, the central nervous system was analyzed for free amino acids. No difference was found between the irradiated and nonirradiated animals; however, the groups differed in the ratio of glucose radioactivity between carotic and jugular blood. (H.B.G.)

50752 EFFECTS OF SINGLE AND WHOLE-BODY FRACTIONATED IRRADIATION ON HYDROXYPROLINE EXCRETION IN RAT URINE. Ladner, H.-A.; Diethelm, L. (Univ., Mainz). pp 83-8 of Biochemisch Nachweisbare Strahlenwirkungen und Deren Beziehungen zur Strahlentherapie. /Gerger, Georg B. (ed.). Stuttgart; Georg Thieme Verlag (1970). (In German).
From Conference on Society of Radiation Biology, Stuttgart, Germany. See CONF-690551.

One group of rats received 400 R whole-body radiation. Within the first two days postexposure, hydroxyproline excretion in the urine decreased, and subsequently increased in comparison to preirradiation values. A second group of rats received whole-body radiation in various fractionated doses; each exposure was followed by suppression of hydroxyproline excretion. A third group received local radiation of 3000 R to the thigh and pelvic area; each exposure was followed by reduction of hydroxyproline excretion. Into a fourth group, a lymphosarcoma was transplanted; twelve days following transplantation local radiation was administered. The tumor group showed increased hydroxyproline excretion prior to radiation; after exposure excretion diminished and recovery was delayed in comparison to controls. (H.B.G.)

50753 EXCRETION OF FREE AMINO ACIDS IN URINE FOLLOWING WHOLE-BODY IRRADIATION. Leesemann, D.; Streffer, C. (Univ., Freiburg i. B.). pp 89-93 of Biochemisch Nachweisbare Strahlenwirkungen und Deren Beziehungen zur Strahlentherapie. /Gerber, Georg B. (ed.). Stuttgart; Georg Thieme Verlag (1970). (In German).
From Conference on Society of Radiation Biology, Stuttgart, Germany. See CONF-690551.

In mice, excretion of amino acids was determined in the urine. After establishment of stable values, the animals received 690 R of ionizing radiation. During the first two days, enhancement occurred in the urinary excretion of all amino acids with the exception of cysteine and cystine. On the third day postexposure, urinary excretion values returned to normal. (H.B.G.)

50754 RELEASE OF BIOLOGICALLY ACTIVE AMINES AND EXCRETION OF THEIR METABOLITES IN EXPERIMENTAL RADIOBIOLOGY AND CLINICAL RADIOLOGY. Supek, Z.; Deanovic, Z. (Inst. Rudjer Boskovic, Zagreb). pp 97-105 of Biochemisch Nachweisbare Strahlenwirkungen und Deren Beziehungen zur Strahlentherapie. /Gerber, Georg B. (ed.). Stuttgart; Georg Thieme Verlag (1970). (In German).
From Conference on Society of Radiation Biology, Stuttgart, Germany. See CONF-690551.

Urinary excretion of biologically active amines is reviewed. Included in the analysis are acetylcholine, catecholamine, 5-hydroxytryptamine, serotonin, histamine, and 5-hydroxyindolacetic acid. Sublethally x-irradiated rats show excretion patterns from which survival time can be predicted. 60 references are given. (H.B.G.)

50755 ENZYME ACTIVITY IN EXPERIMENTAL RADIOBIOLOGY AND CLINICAL RADIOLOGY. Kaercher, K. H. (Univ., Vienna). pp 107-20 of Biochemisch Nachweisbare Strahlenwirkungen und Deren Beziehungen zur Strahlentherapie. /Gerber, Georg B. (ed.). Stuttgart; Georg Thieme Verlag (1970). (In German).
From Conference on Society of Radiation Biology, Stuttgart, Germany. See CONF-690551.

Changes in the enzyme pattern as induced by ionizing radiation are analyzed for experimental animals and radiotherapy patients. In vitro, relatively high radiation doses are required for significant effects on enzyme activity. In vivo, however, relatively small doses produce significant effects. Tumor patients frequently show organ-specific enzyme patterns that differ from normal ones. Therefore, observation of the enzyme pattern is useful for assessment of clinical improvement in patients treated with radiation or chemotherapy. The following enzymes are discussed: aminopeptidase, glutamate oxalacetate transaminase, γ-glutamylpeptidase, leucine aminopeptidase, lactate dehydrogenase, malate dehydrogenase, and nicotinamideadenine dinucleotide. Eleven diagrams and 22 references are included. (H.B.G.)

50756 COMPARATIVE HISTOCHEMICAL ENZYME ANALYSIS FOLLOWING WHOLE-BODY IRRADIATION OF RATS. Walther, G.; Ladner, H.-A.; Schmidt, K.-J. (Univ., Mainz). pp 121-6 of Biochemisch Nachweisbare Strahlenwirkungen und Deren Beziehungen zur Strahlentherapie. /Gerber, Georg B. (ed.). Stuttgart; Georg Thieme Verlag (1970). (In German).
From Conference on Society of Radiation Biology, Stuttgart, Germany. See CONF-690551.

In rat organs the following enzymes were determined: Glutamate dehydrogenase (GluDH), leucineaminopeptidase (LAP), and monoamineoxidase (MAO). Three groups were studied: nonirradiated controls, a 650 R whole-body irradiated group, and a 1950 R whole-body irradiated group. Values obtained for liver, kidney, heart, spleen, adrenal gland, and ovary at 24 hrs, 48 hrs, and 72 hrs postradiation were compiled in three tables corresponding to each enzyme. (H.B.G.)

50757 EFFECTS OF WHOLE-BODY IRRADIATION ON TRYPTOPHAN OXYGENASE IN RAT LIVERS. Benes, J.; Zicha, B. (Charles Univ., Prague). pp 127-32 of Biochemisch Nachweisbare Strahlenwirkungen und Deren Beziehungen zur Strahlentherapie. /Gerber, Georg B. (ed.). Stuttgart; Georg Thieme Verlag (1970). (In German).
From Conference on Society of Radiation Biology, Stuttgart, Germany. See CONF-690551.

Rats received 1400 R whole-body radiation and the enzyme tryptophan oxygenase was determined in the liver. At 24, 48, and 72 hours postradiation, enzyme activity was significantly enhanced. The findings were explained as a radiation effect on messenger RNA. (H.B.G.)

50758 EFFECTS OF WHOLE-BODY X IRRADIATION ON LACTATE DEHYDROGENASE AND ITS ISOENZYMES IN HYPOXIC RATS. Braun, H.; Hornung, G.; Courtois, C. (Univ., Wuerzburg, Ger.). pp 132-40 of Biochemisch Nachweisbare Strahlenwirkungen und Deren Beziehungen zur Strahlentherapie. /Gerber, Georg B. (ed.). Stuttgart; Georg Thieme Verlag (1970). (In German).
From Conference on Society of Radiation Biology, Stuttgart, Germany. See CONF-690551.

Rats received 600 R whole-body x radiation. For six hours they were kept under hypoxic conditions either prior, during, or following radiation. On the second day postradiation, lactate dehydrogenase and its isoenzymes were determined in homogenates of heart, kidney, muscle, spleen, brain, liver, small intestine, and serum. The various enzyme patterns found after radiation and hypoxia were presented in 21 diagrams. (H.B.G.)

50759 BEHAVIOR OF GLUTAMATE OXALACETATE TRANSAMINASE IN ERYTHROCYTES OF TUMOR PATIENTS TREATED WITH RADIATION. Ladner, H.-A.; Jakobus, H.; Buchwald, W. (Univ., Mainz). pp 144-8 of Biochemisch Nachweisbare Strahlenwirkungen und Deren Beziehungen zur Strahlentherapie. /Gerber, Georg B. (ed.). Stuttgart; Georg Thieme Verlag (1970). (In German).
From Conference on Society of Radiation Biology, Stuttgart, Germany. See CONF-690551.

In 15 female tumor patients, GOT activity of erythrocytes was determined prior to and subsequent to radiation therapy. In comparison to 50 nonirradiated control persons, enzyme activity

showed only moderate inhibition at the end of the treatment period. Because of the small number of patients, findings were not statistically significant. In several patients, GOT values indicated a disturbance of vitamin B6 metabolism. Continued use of the procedure seemed justified for the study of interrelationships between vitamin-E[2] metabolism, total radiation dose, type of tumors, and GOT activity in erythrocytes. (H.B.G.)

50760 RADIOSENSITIVITY OF MALIGNANT THORAX TUMORS AND CHANGES IN SERUM TRANSAMINASE ACTIVITY. Graegner, H. F.; Hardt, H. (Univ., Giessen, Ger.). pp 149-56 of Biochemisch Nachweisbare Strahlenwirkungen und Deren Beziehungen zur Strahlentherapie. /Gerber, Georg B. (ed.). Stuttgart; Georg Thieme Verlag (1970). (In German).

From Conference on Society of Radiation Biology, Stuttgart, Germany. See CONF-690551.

One hundred twenty four male patients with either bronchial carcinoma or mediastinal tumors were treated with ^{60}Co γ radiation. Serum transaminase was determined daily during the radiation treatment period. Radiotherapy caused an increase of enzyme activity followed by a return to normal with progression of therapy. Lymphomas, in comparison to bronchial carcinomas, showed a more pronounced increase of enzyme activity and a faster return to normal values. It was concluded that transaminase determination could be of value to distinguish undifferentiated malignancies and generalized disease processes from localized well differentiated mediastinal tumors. (H.B.G.)

50761 EFFECT OF ULTRAVIOLET AND GAMMA RADIATION ON THE FRICTION OF COLLAGEN FIBERS. Goverdhan Rao, D. P.; Ramanathan, N. (Central Leather Research Inst., Madras). Sci. Cult. (Calcutta); 35: 502-6(Sep 1969).

Collagen was obtained from tendons of kangaroo and rat tails and was exposed to ultraviolet and γ radiation. The effects of radiation was to degrade the surface of the collagen fibers and to destroy the directional friction effect. The rat tail fibers were more resistant to the degrading forces as evidenced by retention of the directional friction effect up to an exposure of 2.5 hrs of ultraviolet radiation of beam energy 5000 ergs/sec/sq.cm. and 10 Mrads of γ radiation. By contrast, the kangaroo tail fibers withstood ultraviolet radiation up to 1.5 hrs and γ radiation up to a dose of 5 Mrad. Electron microscopy revealed that the surface of the irradiated fibers was degenerated; this explained the disappearance of the directional friction effect following irradiation. (H.L.W.)

50762 SOME EFFECTS OF γ RAYS ON 30 S RIBOSOME PARTICLES. Ekert, Bernard; Di Stefano, Sylvie; Gendillout, Annick (Institut du Radium, Paris). Compt. Rend., Ser. D; 270: 3148-51(22 Jun 1970). (In French).

When 30 S ribosome particles are irradiated with ^{60}Co γ rays their ability to form a ternary complex with Poly U and ^{14}C phenylalanyl t RNA decreases exponentially with the radiation dose. Reassociation of these irradiated particles with intact 50 S particles restores a large fraction of this activity. In addition these reconstituted particles display different activities for the formation of the ternary compound and for the synthesis of polyphenylalanine. Various hypotheses are put forward to explain these results. (auth) (France)

50763 IRRADIATION OF RIBOSOMES BY ULTRAVIOLET: ACTION SPECTRUM OF INACTIVATION OF SYNTHESIS FUNCTION. Ekert, Bernard; Muel, Bernard; Latarjet, Raymond (Institut du Radium, Paris). Biochim. Biophys. Acta; 204: 275-7(Mar 1970). (In French).

Studies on action spectra were undertaken to determine whether the ultraviolet light responsible for inactivating the synthetic function of ribosomes was absorbed by the protein or the ribonucleic part of the ribosome. Inactivation of the synthesis of polyphenylalanine in the presence of polyuridilic acid was investigated. A suspension of Escherichia coli ribosomes was irradiated at 237 to 297 nm, and a figure is presented to show inactivation curves at four wavelengths. Curves of absorption of ribosomal RNA and of a protein having an amino acid composition similar to that of ribosomal protein are shown. Significant differences are seen between the action spectrum and these two spectra. It appears that the absorption by the proteins occurs near the absorption by RNA in the process of inactivation. (H.L.W.)

50764 GENETIC ANALYSIS OF ULTRAVIOLET LESIONS OF PHAGE TRANSFORMING DNA rII$^+$ MARKERS. II. STIMULATION OF TRANSFORMATION AND DONOR DNA REPARATION. Vinetskii, Yu. P.; Aleksandrova, N. M. (Inst. of General Genetics, Moscow). Genetika; 6: No. 8, 147-50(Aug 1970). (In Russian).

It was shown that under transformation of the T4 r164 irradiated donor DNA with deletions surrounding the rII$^+$ 164 marker from the right and left sides, stimulation of recombination is observed at small doses of uv irradiation. In Escherichia coli cells B_{s-1} stimulation did not take place. The curve of donor DNA marker rII-638 rescue had the slope twice as steep, if in non-irradiated phage-recipient, the reparation system, that is controlled by v-gene, was disturbed. The product of v-gene action was capable of repairing irradiated denaturated phage T4 DNA. (auth)

50765 RADIOSENSITIZATION WITH IODINE COMPOUNDS. I. EXAMINATION OF DAMAGE IN DNA WITH BACILLUS SUBTILIS TRANSFORMATION SYSTEM BY IRRADIATION IN THE PRESENCE OF POTASSIUM IODIDE. Kada, Tsuneo (National Inst. of Genetics, Mishima, Japan); Noguti, Takehiko; Namiki, Mitsuo. Int. J. Radiat. Biol.; 17: 407-18(1970).

To study whether radiation sensitization with iodine compounds, such as potassium iodide (KI), potassium iodate (KIO_3) or iodoacetic acid ($ICH_2 \cdot COOH$), involves increased damage to DNA, studies were carried out on the transformation system of Bacillus subtilis. Radiation-sensitizing effects, especially marked at low pH, were observed when bacteria were irradiated in the presence of these agents. When transforming DNA was irradiated in vitro, the inactivation of genetic capacity was greatly protected by the addition of KI. This protective effect was also found in the radiolysis of four DNA bases dissolved in water. When DNA was extracted by the phenol method from irradiated cells and the transforming capacity measured, no remarkable difference was observed as to the arginine marker, whether bacteria sensitized by KI or not when irradiated. Alkaline-sucrose gradient studies showed that the number of single-stranded breaks from irradiated cells was not enhanced by the addition of KI during irradiation. Because damage to DNA was not enhanced by the presence of the sensitizer whether DNA was irradiated in vitro or in vivo, it is supposed, at least in the case of KI, that the radio-sensitization may be not due to the enhancement of non-specific damages in cellular DNA. (auth) (UK)

50766 A RADIOBIOLOGICAL STUDY OF INTERFERON FORMATION: EFFECTS OF MONOCHROMATIC UV RAYS AND EFFECTS OF UV RAYS ON BROMODEOXYURIDINE-SUBSTITUTED CELLS. Coppey, Jacques; Muel, Bernard (Institut du Radium, Paris). Int. J. Radiat. Biol.; 17: 431-7(1970).

The efficiency ratio of two bands of uv, 252 mμ to 237 mμ, in inactivating interferon messenger-RNA transcription, equals 2 and is the same as the ratio of absorption of nucleic acids. This suggests that uv acts by inducing primary photolesions in the corresponding cistrons of DNA. The inactivation efficiency ratio of these two bands on the ribosomal process of interferon formation equals one, a value in agreement with that determined on bacterial ribosomes by others. The radiosensitivity of interferon messenger-RNA transcription is increased in BUdR-substituted cells, as a function of the percentage of BUdR-substitution. The BUdR-sensitization allows an accurate evaluation of the kinetics of interferon m-RNA transcription. (auth) (UK)

50767 COMPARISON OF THE ENERGY OF LETHAL DOSES OF GAMMA RADIATION, VISIBLE LIGHT, AND THE ENERGY OF CELLULAR BASAL METABOLISM. Ozerskii, M. I. Sb. Tr. Agron. Fiz.; No. 17, 51-3(1969). (In Russian).

On the basis of published data, the energy of lethal doses of gamma radiation (E_γ), visible light (E_{hv}), and the energy of basal metabolism (E_c) of the bacterial cell were compared. The dose of gamma radiation capable of inactivating cells was assumed to be 10^3 r, with inactivation by visible light occurring after irradiation with an energy of 10 j/m^2. The basal metabolic energy of the bacterial cell was calculated as the total energy expended on hydrolysis of the ATP macroerg bonds. The expenditure of energy on the synthesis (restoration) of peptide, glucoside, phosphate, and other molecules, as well as on active transport and intracellular activity, was taken into consideration. The energy of a lethal dose of gamma radiation was calculated to be several orders lower than the energy of a lethal dose of visible light or the energy of cellular basal metabolism. The respective values are as follows: $E_\gamma \sim 2.6 \cdot 10^{-15}$ cal; $E_{hv} \sim 2.1 \cdot 10^{-11}$ cal; $E_c \sim 5 \cdot 10^{-10}$ cal/hour. (JPRS)

50768 EVALUATION OF THYROID FUNCTION BY THE ^{131}I UPTAKE CURVES IN PATIENTS TREATED BY ^{60}Co. Biscarini, Remo. Radiaz. Alta Energ.; 8: 169-81(Oct 1969). (In Italian).

Evaluation of thyroid function by means of ^{131}I uptake curves, in subjects suffering from extra-thyroid malignancies and having been irradiated with ^{60}Co, shows alterations, at the end of the treatment, in terms of indirect damage, not in euthyroid patients, but only in hyperthyroid ones. With the latter, indeed, the high levels of the ^{131}I uptake curves found before the ^{60}Co teletherapy, decrease, sometimes quite notably, at the end of the treatment. (auth)

50769 EFFECT OF IPRONIAZID ON EXCRETION OF AROMATIC AMINES IN X-IRRADIATED RATS. Hadkarni,

G. B.; Raghavan, K. G. (Bhabha Atomic Research Centre, Bombay). Int. J. Radiat. Biol.; 18: 95-8(1970).

Male Wistar rats of 180 to 200 g were exposed to whole body x radiation of 600R. .Urinary excretion profiles are presented of tyramine, tryptamine, and taurine, in control, x irradiated, and rats injected with 7.2 μ moles/rat of iproniazid, with or without radiation. Maximum increases were observed 24 hrs after x irradiation, with a decline at 48 hrs. Iproniazid administration resulted in increased excretion of tyramine and tryptamine, persisting at 48 hrs., but did not affect taurine levels. When administered to x irradiated rats it caused a 5-fold increase in tyramine and tryptamine excretion, the additive effect still being present at 48 hrs. The effect on liver aromatic-L-aminoacid decarboxylase was measured with tryptophan and tyrosine as substrates. Decarboxylase activity was enhanced after x radiation, maximum increase being at 4 hrs., high after 24 hrs. and levelled off at 48 hrs. Iproniazid did not affect decarboxylation of either substrate. The responses of rat liver MAO using tyramine, tryptamine and 5-hydroxytryptamine were measured. At 4, 24, and 48 hrs. after whole body x radiation, liver MAO activity showed little variation from the control value, whereas injected rats showed 70 to 80% decrease in activity at 24 and 48 hrs. (UK)

50770 RNA SYNTHESIS AND URIDINE POOLS IN NORMAL AND BUdR CONTAINING KIDNEY T-CELLS AFTER U.V.-IRRADIATION. Scaife, J. F. (EURATOM, Varese, Italy). Int. J. Radiat. Biol.; 18: 189-92(1970).

The rate of uptake of ^{3}H-uridine (uridine-5-^{3}H, 1500 mCi/mM at 0.5 μCi/ml) into acid-soluble and insoluble fractions of T cells was measured. The ratio of ribonucleoside pool label to RNA label indicated a larger pool than that of thymidine, and that the pool turnover rate was slow (equilibrium was not reached after 90 min and 22% of the label was extracted after a 30 min pulse). A dose-response curve was obtained for the inhibition of RNA synthesis in normal and BUdR cells after U.V. irradiation (30 min pulses of doses from 0-200 ergs/mm^{2}). Incorporation of the label into RNA was more reduced in BUdR containing cells than in normal cells and activity in the acid soluble pool was reduced with increasing dose, while being increased in that of normal cells. At 100 and 200 ergs/mm^{2}, recovery of RNA synthesis occurred in BUdR cells 2-3 hrs after irradiation but not in normal cells, (where there was a progressive decrease in incorporation, and similar results were obtained for pool activity. 200 ergs/mm^{2} gave a 42% inhibition of protein synthesis in BUdR cells and 13% inhibition in normal cells. (Protein synthesis was measured by incorporation of L-histidine-2, 5-^{3}H 7500 mCi/mM at 1μCi/ml.) The acid soluble uridine pool of cells pulsed for 30 min was examined by DEAE cellulose column chromatography. 12% of the label was found as unchanged uridine, the rest as monoribonucleotides. (UK)

50771 INFLUENCE OF RADIATION QUALITY AND OXYGEN ON STRAND BREAKAGE IN DRY DNA. Neary, G. J. (Medical Research Council, Harwell, Eng.); Simpson-Gildemeister, V. F. W.; Peacocke, A. R. Int. J. Radiat. Biol.; 18: 25-40(1970).

DNA isolated from T7 phage or deposits of this phage were irradiated with various qualities of radiation, including track-segment irradiations by charged heavy particles. The amount of single- and double-strand breakage was determined by analysis of the sedimentation boundary in an analytical ultracentrifuge. The results show that a single-strand break is produced on average for each energy-loss event in the DNA molecule; an energy-loss event has a chance of about 1 in 20 of producing a double-strand break, with little dependence on LET in the range up to 100 keV/μm and there is no significant effect of oxygen on the production of either single- or double-strand breaks. (auth) (UK)

50772 EFFECTS OF GAMMA RADIATION AND ETHYLENE TREATMENT ON THE ACTIVITY OF SUCCINATE OXIDATION OF MITOCHONDRIAL FRACTION IN TOMATOES. Kato, Katsuichi (Shizuoka Univ., Iwata, Japan). Nippon Shokuhin Kogyo Gakkaishi; 17: No. 2, 77-9(Feb 1970). (In Japanese).

The respiratory control ratio (RC ratio) of mitochondrial fraction isolated from the 250 Krad-fruits immediately after irradiation was lower than that from the unirradiated ones, but the RC ratio in 250 Krad sample became higher during ripening in contrast to the decrease of RC ratio in unirradiated ones. The mitochondrial fraction isolated from ethylene treated (500 ppm for 18 hours) fruits, both the unirradiated and 500 Krad-fruits temporarily showed the rapid oxidation of succinate with addition of ADP and the RC ratio was 1.0. (auth) (Japan)

50773 METABOLISM OF HISTIDINE IN X-IRRADIATED RATS IN RELATION TO HISTAMINE AND DIAMINE OXIDASE. Raghavan, K. G.; Nadkarni, G. B. (Bhabha Atomic Research Centre, Bombay). Int. J. Radiat. Biol.; 18: 51-60(1970).

The effect of x irradiation (600 R) on rats was ascertained with reference to histamine by assessing the activities of rat liver enzymes and following up radioactivity in vivo in the metabolites after intraperitoneal injection of histidine-U-^{14}C. Rat-liver histidine decarboxylase showed enhanced activities immediately (4 hours) after irradiation, showing a decline at 24 hours and return to normal values at 48 hours. Liver histaminase, a diamine oxidase, showed a decrease at 4 hours with no variation from the control values at the other time-intervals. Histidase gave a similar response, but urocanase was unaffected by x irradiation. The recovery of radioactivity of administered histidine-U-^{14}C in histamine was increased 2 to 5 fold in various organs, including liver, kidney, and spleen. The increase in the labelling of histamine in vivo was maximum. Radioactivity in the other metabolites, namely urocanic acid, imidazoleacetic acid and imidazoleacetic riboside and methylhistamine, was in accordance with the activities of the enzyme studied. (auth) (UK)

50774 IRRADIATION-INDUCED CHANGES IN THE VOLATILE CONSTITUENTS OF VALENCIA ORANGES. Braddock, R. J.; Wolford, R. W.; Dennison, R. A.; Ahmed, E. M. (Univ. of Florida, Gainesville). J. Amer. Soc. Hort. Sci.; 95: 437-41 (1970).

Volatile compounds were extracted from juices expressed from non-irradiated and irradiated Valencia oranges. Gas chromotographic analyses of the recovered volatile compounds, at 3 stages of maturity, indicated some quantitative but few qualitative differences between the irradiated and non-irradiated fruits. These differences diminished as the fruit advanced in maturity. (auth)

Immunology

Refer also to abstracts 50666, 50943, 51011, and 51081.

50775 (CALT-767-P-6-3) STUDIES IN DEVELOPMENTAL IMMUNOGENETICS. Annual Progress Report. Owen, Ray D. (California Inst. of Tech., Pasadena. Div. of Biology). 28 Aug 1970. Contract AT(04-3)-767. 10p. Dep. CFSTI.

Data are reported from studies of bio-chemical genetics primarily from a developmental viewpoint, and of immunologic interactions between generations with particular regard to brain development, the flow of information through the nervous system, and cellular aspects of the development of the immunologic system. Results are included from studies on x-irradiated mice that indicate two cell lines are involved in the immune response and that the antibody-forming precursal cell is of bone marrow origin. Mice that had received graft-prolonging anti-lymphocyte serum (ALS) were studied for their antibody response to serum antigens. Some of the ALS-treated mice developed spontaneous tumors within six months following treatment. The antigenic properties of these tumors were studied in an attempt to elucidate the mechanism of spontaneous tumor induction. Pigeons were found to survive a whole-body dose of 1750 R x radiation. (C.H.)

50776 (STI/PUB-242) ISOTOPES AND RADIATION IN PARASITOLOGY, [PART] II. Proceedings of the Research Co-Ordination Meeting held in Vienna, 2-6 June 1969. (International Atomic Energy Agency, Vienna (Austria)). May 1970. 141p. (CONF-690642). IAEA $4.00.

Separate abstracts were prepared for 11 papers presented at the conference. An additional six papers were presented on various aspects of helminth infections. (H.L.W.)

For abstracts of individual papers see: 50671, 50672, and 50783-50791.

50777 HISTOPATHOLOGICAL ALTERATIONS IN LUNGS OF CHICKENS IMMUNIZED WITH IRRADIATED SYNGAMUS TRACHEA LARVAE. Varga, I.; Vetesi, F. (Univ. of Veterinary Science, Budapest). Acta Vet. Acad. Sci. Hung.; 20: 183-93 (1970).

The lung lesions produced by irradiated Syngamus trachea larvae administered at the age of one day to chickens were studied. These changes were compared to those resulting from challenge with normal larvae 2 weeks later and also to those found in chickens infected at the age of 2 weeks without previous immunization. Immunizing larvae produced slight microscopic changes. The initial features were hyperemia, hemorrhages due to larval migration and moderate infiltration of parabronchi by lymphocytes. Later, marked and longer-lasting hyperplasia of lymphoid elements occurred in the lungs. The alterations created by irradiated larvae were comparable to those brought about by normal larvae. Cellular reaction in immunized animals was enhanced as a result of challenge with normal larvae. (auth)

50778 MEASUREMENT OF IgA LEVELS IN HUMAN CORD SERUM BY A NEW RADIOIMMUNOASSAY. Faulkner, W.; Borella, L. (St. Jude Children's Research Hospital, Memphis, Univ. of Tennessee, Memphis). J. Immunol.; 105: 786-90(Sep 1970).

A new quantitative inhibition immunoassay for measurement of human IgA has been developed, based on the Single Antibody Millipore Filtration (SAMF) method of Borella. IgA labeled with ^{125}I was mixed with anti-human IgA serum, incubated for 24 hr at 37°C and filtered through a 220-mμ pore size Millipore filter. Labeled antigen-antibody complexes were retained by the filter while unbound ^{125}I IgA was filtered through. The concentration of IgA specifically bound to antibody was calculated by the radioactivity retained in the filter. Addition of nonlabeled IgA to the reaction mixture inhibited the binding of ^{125}I IgA by antibody. Between 20% and 80%, this inhibition was a linear function of the concentration of nonlabeled IgA. This immunoassay was used to measure the concentration of IgA in cord serum and all of 60 specimens had measurable levels of IgA. The mean value was 0.8 mg%, ranging from 0.15 mg% to 2.15 mg%. The SAMF immunoassay is rapid, reproducible and highly sensitive and should provide an ideal method for future studies on the ontogenetic development of IgA and its relationship to perinatal infections. (auth)

50779 INITIATION OF ANTIBODY RESPONSES BY DIFFERENT CLASSES OF LYMPHOCYTES. III. DIFFERENCES IN THE PROLIFERATIVE RATES OF THORACIC DUCT LYMPHOCYTES INVOLVED IN PRIMARY AND SECONDARY RESPONSES. Strober, Samuel (National Cancer Inst., Bethesda, Md.). J. Immunol.; 105: 734-7(Sep 1970).

Thoracic duct cells from normal and immunized Lewis rats restored the antibody response of x-irradiated hosts to Salmonella typhi flagella and horse spleen ferritin. Elimination of the large dividing lymphocytes by treatment of the cell donors with the mitotic inhibitor, vinblastine, or by in vitro incubation of the thoracic duct cells markedly reduced the responses restored by cells from normal donors. On the other hand the responses restored by thoracic duct cells from immunized donors were not reduced by elimination of dividing cells and were dramatically enhanced in the case of horse spleen ferritin. These findings suggest that rapidly dividing thoracic duct cells play an important part in the immunologically competent unit for S. typhi flagella and horse spleen ferritin in normal rats but not in immunized rats. (auth)

50780 CONCERNING THE ENTERAL VACCINATION OF THE IRRADIATED MICE WITH HEATED TYPHOID VACCINE. Tumanyan, M. A.; Nikolaeva, L. A. Zh. Mikrobiol., Epidemiol. Immunobiol.; No. 6, 28-31(1970). (In Russian).

It was shown that enteral vaccination with typhoid vaccine after radiation injury of the organism promoted restoration of reduced natural resistance. The efficacy of enteral vaccination depended on the irradiation dose and the time interval between the irradiation and the commencement of vaccination. (auth)

50781 CLINICAL UTILITY OF RADIOIMMUNOASSAYS FOR SERUM FOLLICLE-STIMULATING HORMONE (FSH) AND LUTEINIZING HORMONE (LH). Ryan, Robert J.; Cloutier, Mark D.; Hayles, Alvin B.; Paris, Jaime; Randall, Raymond V. Med. Clin. N. Amer.; 54: 1049-59(Jul 1970).

The double-antibody radioimmunoassay method was used for measurement of serum LH and FSH. Techniques employed for the tests are described. Results are tabulated for serum concentrations of LH and FSH in normal men and women to show variations with age, time of day, and over a period of days. Data are reported for serum FSH and LH in patients with the following disorders: boys with late onset of puberty, boys with idiopathic hypopituitary dwarfism, isosexual precocious puberty, Turner's syndrome, Klinefelter's syndrome, hypogonadotrophic hypogonadism, men with pituitary tumors, men with acromegaly, and women with pituitary tumors. (H.L.W.)

50782 CHANGES IN THE SIZE OF COLONIES ON THE SPLEEN, FORMED FROM IRRADIATED AND INCUBATED BONE MARROW CELLS. Kharlamova, L. A. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya; 10: 369-72(May-Jun 1970). (In Russian).

Weight dependence of colony formation in the spleen was analyzed in mice. Recipients were injected with a freshly prepared suspension of bone marrow cells, irradiated or incubated in vitro. A correlation was established between weight per colony (the regression coefficient) and colony size; largest values for regression coefficients were found when freshly prepared cell suspensions were injected. Irradiation or incubation of the cells in vitro decreased regression coefficients. (JPRS) (TSS)

50783 A SIMULATED FIELD TRIAL OF AN IRRADIATED CANINE HOOKWORK VACCINE. Miller, T. A. (Univ. of Glasgow); Baker, J. D.; Hein, V. D.; Steves, F. E. pp 7-13 of Isotopes and Radiation in Parasitology. Part II. Vienna, International Atomic Energy Agency (1970).

From Meeting on the Use of Isotopes and Radiation in Studies of Parasitic Diseases in Domestic Animals, Vienna, Austria. See STI/PUB-242; CONF-690642.

Two experiments are described in which pups were twice vaccinated by subcutaneous inoculation of an x-irradiated larval vaccine of Ancylostoma caninum. The immunities of the vaccinated pups and of similar but unvaccinated control pups were then challenged by either natural exposure to an infective hookworm-contaminated environment or by an experimental subcutaneous inoculation of normal larvae. Highly significant protection was exhibited by the vaccinated pups compared with their controls, since hookworm burdens from the challenge infections were reduced by 88 to 95%. All vaccinated pups survived the challenge in good clinical and haematologic health while the controls were clinically severely affected and their haematologic values were severely depressed. In the second experiment the severe natural challenge proved to be an LD_{70} for unvaccinated controls while vaccinates were completely unaffected. (auth)

50784 SUBCUTANEOUS IMMUNIZATION OF GUINEA PIGS WITH DICTYOCAULUS VIVIPARUS LARVAE ATTENUATED BY X-IRRADIATION. Tomanek, J. (Veterinary Research Inst., Brno-Medlanky, Czech.). pp 15-17 of Isotopes and Radiation in Parasitology. Part II. Vienna, International Atomic Energy Agency (1970).

From Meeting on the Use of Isotopes and Radiation in Studies of Parasitic Diseases in Domestic Animals, Vienna, Austria. See STI/PUB-242; CONF-690642.

Groups of guinea pigs were immunized subcutaneously with two doses of 5000 infective Dictyocaulus viviparus larvae attenuated by exposure to 20, 30, 40 and 50 kR. Twelve days after the second inoculation they were challenged orally with 5000 infective Dictyocaulus viviparus larvae. Protective immunity was assessed on the basis of larval recoveries from guinea pig lungs 7 days after challenge. The groups that received irradiated larvae all showed approximately the same immunizing effect, except for the 40 kR group. The control group that was inoculated subcutaneously with unirradiated larvae showed a markedly higher immunizing effect. (auth)

50785 IRRADIATION OF DICTYOCAULUS VIVIPARUS LARVAE WITH A LINEAR ACCELERATOR. Tomanek, J.; Prochazka, Z. (Veterinary Research Inst., Brno-Medlanky, Czech.). pp 19-22 of Isotopes and Radiation in Parasitology. Part II. Vienna, International Atomic Energy Agency (1970).

From Meeting on the Use of Isotopes and Radiation in Studies of Parasitic Diseases in Domestic Animals, Vienna, Austria. See STI/PUB-242; CONF-690642.

A comparison was made of the relative biological efficiency of a linear accelerator (1.6 MeV, 10 μA, dose-rate 3×10^5 rads/min) and an x-ray machine to attenuate Dictyocaulus viviparus larvae. The degree of attenuation was expressed by the number of larvae recovered from guinea pig lungs 10 days after infection with 5000 larvae. Differences in the number of larvae found in the individual groups exposed to 20, 40, 60 and 80 kR emitted by the accelerator were negligible. However, some differences were found in the developmental stage of the larvae between the group exposed to 20 kR and those exposed to higher doses. Twice the radiation dose was required with the accelerator as with the x-ray machine to obtain the same degree of larval attenuation. Standardization of radiation doses emitted by the accelerator presented difficulties owing to the high dose-rate and the short time of radiation treatment. (auth)

50786 PATHOPHYSIOLOGY AND IMMUNOLOGY OF INFECTIONS WITH NON-IRRADIATED AND IRRADIATED METACERCARIAE OF FASCIOLA HEPATICA. Movsesijan, M.; Cuperlovic, K. (Inst. for the Application of Nuclear Energy, Zemun, Yugoslavia). pp 23-34 of Isotopes and Radiation in Parasitology. Part II. Vienna, International Atomic Energy Agency (1970).

From Meeting on the Use of Isotopes and Radiation in Studies of Parasitic Diseases in Domestic Animals, Vienna, Austria. See STI/PUB-242; CONF-690642.

Four groups of rabbits were treated with metacercariae of Fasciola hepatica. One group was given an oral dose of non-irradiated metacercariae and three groups were given oral doses of metacercariae that had been x-irradiated with 1, 2 and 3 kR respectively. The fifth group served as an untreated control. Irradiation of metacercariae of F. hepatica with 2 and 3 kR caused a significant decrease in the number of parasites that developed after injection and attenuated the metacercariae to such a degree that they could not produce anaemia. Antibodies against F. hepatica in rabbits infected with irradiated and non-irradiated metacercariae were detected by complement fixation, double diffusion precipitation, miracidial immobilization and the fluo-

rescent antibody test. The hemagglutination test was less suitable. (auth)

50787 IMMUNIZATION OF CHICKENS WITH IRRADIATED LARVAE OF SYNGAMUS TRACHEA. Varga, L.; Vetesi, F. (Univ. of Veterinary Sciences, Budapest). pp 55-62 of Isotopes and Radiation in Parasitology. Part II. Vienna, International Atomic Energy Agency (1970).

From Meeting on the Use of Isotopes and Radiation in Studies of Parasitic Diseases in Domestic Animals, Vienna, Austria. See STI/PUB-242; CONF-690642.

In a field trial 2.8% of 527 chickens immunized with irradiated Syngamus trachea larvae died of gapeworm disease compared with 74.5% of 342 controls. In other field experiments carried out in a dry season the incidence of infection was low. Nevertheless, the protection level of immunized chickens based on worm burdens was comparable to that in a laboratory challenge. A dose of about 150 irradiated larvae administered to one-day-old chicks causes only mild lesions in the lungs. These are first characterized by hyperaemia and lympho-histiocyte infiltration of the parabronchi and later by hyperplasia of the lymphoid elements. The occurrence of leucocytes with eosinophilic granules in the cellular reaction was scanty. The tissue reaction appears to be enhanced as a result of challenge. (auth)

50788 IMMUNIZATION AGAINST AFRICAN TRYPANOSOMIASIS BY GAMMA RADIATION. Duxbury, R. E.; Sadun, E. H. (Walter Reed Army Inst. of Research, Washington, D. C.). pp 83-95 of Isotopes and Radiation in Parasitology. Part II. Vienna, International Atomic Energy Agency (1970).

From Meeting on the Use of Isotopes and Radiation in Studies of Parasitic Diseases in Domestic Animals, Vienna, Austria. See STI/PUB-242; CONF-690642.

Trypanosoma rhodesiense exposed to varied doses of gamma irradiation up to 1,000,000 R were inoculated into mice and rats. Mice inoculated with unirradiated trypanosomes developed progressive infections and died 3-5 days after inoculation, with an average survival time of 3.6 days. Conversely, all those inoculated with trypanosomes which had been irradiated at doses of more than 20,000 R survived. The trypanosomes exposed up to 160,000 R retained their motility and normal outline prior to inoculation. Most of the trypanosomes exposed to 320,000 R and all of those examined after exposure to 640,000 or 1,000,000 R had lost their motility. A marked protection to a challenging infection was induced in mice inoculated with irradiated trypanosomes, regardless of the level of irradiation. Whereas 100% survival was observed in the mice which had received 2 or 3 immunizing inoculations, a few of the animals which had received a single immunizing inoculation died after challenge with unirradiated parasites. Similar results were obtained in rats. Fifty-four percent of the rats which had received a single immunizing inoculation, 85% of those with two immunizing inoculations, and 97% of those with three immunizing inoculations survived challenge with unirradiated trypanosomes, whereas non-immunized rats died in an average of 5.7 days. Fluorescent antibody tests in immunized rats indicated development of antibodies following inoculation with irradiated trypanosomes. All the immunized animals survived a second challenge with unirradiated trypanosomes given 1 or 3 months after the first challenge and 13 of 14 survived when rechallenged after 5 months. However, only one of 16 rats survived rechallenge 7 months after the first challenge. A sterile immunity had developed in animals that survived the challenge as evidenced by sub-inoculations with blood, spleen and liver tissues. In attempts at cross-protection, mice given immunizing inoculations of T. brucei, T. gambiense and T. rhodesiense survived challenge with the homologous, but not the heterologous trypanosome species. The feasibility of using frozen, irradiated trypanosomes for immunizing mice was demonstrated. (auth)

50789 IMMUNIZATION IN RODENT AND HUMAN MALARIA BY THE USE OF IRRADIATED PLASMODIA. Sadun, E. H.; Wellde, B. T.; Hickman, R. L. (Walter Reed Army Inst. of Research, Washington, D. C.). pp 97-8 of Isotopes and Radiation in Parasitology. Part II. Vienna, International Atomic Energy Agency (1970).

From Meeting on the Use of Isotopes and Radiation in Studies of Parasitic Diseases in Domestic Animals, Vienna, Austria. See STI/PUB-242; CONF-690642.

Rats infected with Plasmodium berghei parasitized erythrocytes, that had been exposed to doses up to and including 16,000 rads, developed progressive parasitemias. Inoculation with parasitized blood exposed to 20,000 rads stimulated a resistance to a challenge infection with nonirradiated parasites. Experiments were conducted to determine the nature and duration of protection and the dose relationships between immunizing the challenge inocula. Other experiments were undertaken to determine whether protective immunity could be induced in monkeys by inoculating them with irradiated P. falciparum infected erythrocytes. A strong resistance to infection developed in owl monkeys after four weekly immunizations with parasitized red blood cells exposed to 25,000 rads. (H.L.W.)

50790 EFFECT OF WHOLE-BODY IRRADIATION ON IMMUNITY TO ASCARIS SUUM LARVAE IN GUINEA PIGS. Casarosa, L. (Univ., Pisa, Italy). pp 119-24 of Isotopes and Radiation in Parasitology. Part II. Vienna, International Atomic Energy Agency (1970).

From Meeting on the Use of Isotopes and Radiation in Studies of Parasitic Diseases in Domestic Animals, Vienna, Austria. See STI/PUB-242; CONF-690642.

Guinea pigs vaccinated against Ascaris suum and x-irradiated with an LD 50/30 died more rapidly than control animals that were vacinated but not irradiated. The challenge infection in terms of numbers of eggs was much lower than the normal minimum lethal dose. The vaccinated, x-irradiated, and challenged guinea pigs had very high hepatic pulmonary larval migrations compared with the small numbers shown in the vaccinated and challenged but non-irradiated guinea pigs. There was also a considerable inhibition in development of the ascarid larvae. Circumlarval precipitins were equal to or greater than in the control animals. The causes of death of the vaccinated, x-irradiated, and challenged animals and the causes that induced the outstanding hepatic pulmonary larval migration are discussed. (auth)

50791 DICTYOCAULUS FILARIA IN INDIA: PRESENT PROSPECTS FOR USING RADIATION-ATTENUATED VACCINE IN ITS CONTROL. Sokolic, A.; Sharma Deorani, V. P.; Tewari, H. C.; Rao, B. V. (Indian Veterinary Research Inst., Izatnagar). pp 125-8 of Isotopes and Radiation in Parasitology. Part II. Vienna, International Atomic Energy Agency (1970).

From Meeting on the Use of Isotopes and Radiation in Studies of Parasitic Diseases in Domestic Animals, Vienna, Austria. See STI/PUB-242; CONF-690642.

Dictyocaulus filaria infections of sheep and goats are a serious problem in the foothills of the Himalayas. Indications are that the lungworms found in this area are similar to the type prevalent in Europe. If this proves to be true, radiation vaccine of the type developed in Yugoslavia can be expected to be effective under Indian conditions. (auth)

50792 PERSISTENCE OF PRE-IRRADIATION IMMUNITY TO HYMENOLEPIS NANA IN SYNGENEIC CHIMAERAS: INFLUENCE OF RADIATION DOSE AND TIME OF MARROW INJECTION. Friedberg, W. (Civil Aeromedical Inst., Oklahoma City); Cearley, J. E.; Neas, B. R.; Faulkner, D. N.; Coleman, R. L. Int. J. Radiat. Biol.; 17: 449-58(1970).

Mice immunized to Hymenolepis nana were exposed to 950, 1150, 1350 or 1450 R x-radiation, then injected with syngeneic marrow from non-immune donors. Other immunized mice were exposed to 700 R but were not given marrow. To test for persistence of immunity, the mice were challenged with H. nana eggs. Parasite larvae (cysticercoids) developed in only 3 (1 or 2 cysticercoids each) of 40 immunized-unirradiated control mice challenged with eggs. Cysticercoids developed on egg challenge in all unimmunized control mice. There was no difference in cysticercoid counts between immunized-unirradiated controls and either the 700 R group or the mice exposed to 1150 R and given 40×10^6 marrow cells 1 day later. A small number of cysticercoids developed in most of the mice exposed to 1350 or 1450 R and given 40×10^6 marrow cells 1 day after irradiation. Cysticercoids also developed in most of a 950 R group given 0.5×10^6 marrow cells 1 day after irradiation and 40×10^6 cells 20 days later; the cysticercoid counts were not different from those in similarly immunized and irradiated mice given only 0.5×10^6 cells. Thus, no benefit was derived from the second injection of marrow (40×10^6 cells) delayed until 21 days after irradiation. In contrast, in immunized mice given 40×10^6 marrow cells 4 days after 950 R, cysticercoid counts were not different from those in immunized-unirradiated controls. The role of transplanted syngeneic marrow in promoting persistence of immunity acquired before irradiation is discussed. (auth) (UK)

50793 STUDIES ON THE LOCALIZATION OF INJECTED LYMPHOCYTES IN THE SPLEEN WHITE PULP OF IRRADIATED MICE. Davis, Maxie LeRoy. Knoxville, Tenn.; Univ. of Tennessee (1969). 108p. University Microfilms Order No. 70-7556. Thesis.

The functional capability of lymphocytes to localize or home to lymphatic tissues from the peripheral circulation under varying experimental conditions was studied. Attempts were made to influence the number of function of injected lymphocytes localizing in recipient spleens by various pretreatments of the donor lymphocytes and of the recipient. Pretreatment of donor cells was by in vitro or in vivo manipulations such as irradiation, heat-

treatment, serum-incubation, and other means. Pretreatment of the recipients was by exposure to whole-body x-irradition, injection of lymph node lymphocytes, presensitization to donor material, and other means. Lymphocyte cells were injected into the recipients after the various pretreatments used and, in each case, 24 hours after the lymphocyte injection, nucleated spleen cell counts were made on recipient cell suspensions and the topographic localization of cells within the recipient spleens was examined histologically. It was determined that the localization capability of injected lymphocytes could be influenced by the various pretreatments used. It was found that localization could be enhanced by presensitization of the cell donor to recipient tissues. All other experimental approaches resulted in inhibition of lymphocyte localization. (Diss. Abstr.)

50794 RADIOIMMUNOASSAY FOR MEASUREMENT OF ADENOSINE 3',5'-CYCLIC PHOSPHATE. Steiner, A. L.; Kipnis, D. M.; Utiger, R.; Parker, C. (Washington Univ., St. Louis). Proc. Nat. Acad. Sci. U. S.; 64: 367-73(Sep 1969).

A sensitive and specific radioimmunoassay for adenosine 3',5'-cyclic phosphate (cyclic AMP) has been developed which allows measurement of the nucleotide in extracts of 5–10 mg of tissue. The radioimmunoassay is sufficiently specific for cyclic AMP to eliminate the need for prior chromatographic separation of the cyclic nucleotide from other tissue nucleotides. The radioimmunoassay system is based upon competition of cyclic AMP with a labeled cyclic AMP derivative of high specific activity for binding sites on an antibody specific for the cyclic nucleotide. Antibody to cyclic AMP was obtained by immunizing rabbits with an antigen prepared by conjugating succinyl cyclic AMP with human serum albumin. A high specific activity derivative of cyclic AMP was prepared by synthesizing succinyl cyclic AMP tyrosine methyl ester (SCAMP-TME) and iodinating the phenolic hydroxyl group of the tyrosine moiety with ^{125}I. Free and antibody-bound ^{125}I-SCAMP-TME were separated by precipitation of the antibody-bound fraction with a second antibody (goat anti-rabbit gamma globulin). Displacement of ^{125}I-SCAMP-TME by unlabeled cyclic AMP when plotted as a semilogarithmic function was linear over a concentration range of 2–100 picomoles. The specificity of the antibody was tested against structurally related nucleotides, nucleosides, and purine bases. All had less than 0.005 per cent of the potency of cyclic AMP in inhibiting ^{125}I-SCAMP-TME binding. The marked differences in affinity of the various cyclic nucleotides to cyclic AMP antibody would suggest that antibodies can be developed for each of the cyclic nucleotides by the principles used in this work. (auth)

Ecology

Refer also to abstracts 50675, 50705, 50800, 50801, 50843, 50865, 50872, 50937, and 50947.

50795 (ANL-Trans-847) URINARY EXCRETION OF RADIOACTIVE ^{210}Po BY CZECHOSLAVAKIAN URANIUM MINERS. Holgye, A. Translated for Argonne National Lab., Ill., from Cas. Lek. Cesk.; 108: 1450-5(1969). 16p. Dep. CFSTI.

The content of ^{210}Po in the urine of uranium miners who had worked for periods of two to 15 years in mines having a high, medium, or low content of ^{222}Rn in the air was measured. The radiometric procedures used are described. Results showed that miners who had worked for a year or more in mines having a ^{222}Rn concentration in air of 10^{-11} to 10^{-9} Ci/l excreted 0.0 to 3×10^{-12} Ci/l of ^{210}Po in the urine. A statistically significant difference was found in the amount of ^{210}Po excreted by miners working in mines with different levels of air contamination. Only a slight difference in ^{210}Po excretion was found in miners who had worked 1 to 5 years and those who had worked for 5 to 10 years. The contribution of ^{226}Ra, ^{210}Pb, ^{210}Bi, and ^{210}Po in mine dusts to the amount of ^{210}Po excreted in urine is discussed. (C.H.)

50796 (BMI-171-38) REPORT ON THE MARINE FAUNA AND BENTHIC SHELF-SLOPE COMMUNITIES OF THE ISTHMIAN REGION. Bioenvironmental and Radiological-Safety Feasibility Studies, Atlantic-Pacific Interoceanic Canal. Bayer, Frederick M.; Voss, Gilbert L.; Robins, C. Richard (Miami Univ., Fla. Rosenstiel School of Marine and Atmospheric Sciences). 6 Feb 1970. Contract AT(26-1)-171. 488p. Dep. CFSTI.

For Battelle Memorial Inst., Columbus, Ohio.

The construction of a proposed sea-level canal across the Isthmus of Panama could possibly unite the fauna and flora of the Caribbean Sea and the Pacific Ocean by allowing free passage of eggs, larvae, and adults through the canal. It was thought that this might have deleterious effects on one or both faunas. Large collections of invertebrates and fishes from these areas were made. Investigations consisted of taxonomic identifications, computer analysis of the distributions of species to reveal natural communities, analysis of results, and literature surveys. A summary of the geological and paleontological history of the isthmus and its fauna was also undertaken. (H.L.W.)

50797 (BMI-171-39) HUMAN ECOLOGY OF ROUTE 17 (SASARDI-MORTI) REGION, DARIEN, PANAMA. Bioenvironmental and Radiological-Safety Feasibility Studies, Atlantic-Pacific Interoceanic Canal. Torres de Arauz, Reina (Battelle Memorial Inst., Columbus, Ohio). 15 Jun 1970. Contract AT-(26-1)-171. 199p. Dep. CFSTI.

Translated and edited by Felix Webster McBryde.

A summary of human ecology studies in eastern Panama is presented. Emphasis is placed on the area that would be most directly affected by the construction of a sea-level canal using nuclear explosions. The following aspects of human ecology are considered: general relationships between man and his physical environment, demography of the various cultural groups, and quantitative aspects of diets and eating habits as related to ecological, demographic, and cultural characteristics. Appendices are included on plant products, game animal foods used by man, freshwater food fish, and marine food fish and shellfish. (H.L.W.)

50798 (BNL-50220) MEDICAL SURVEY OF THE PEOPLE OF RONGELAP AND UTIRIK ISLANDS THIRTEEN, FOURTEEN, AND FIFTEEN YEARS AFTER EXPOSURE TO FALLOUT RADIATION (MARCH 1967, MARCH 1968, AND MARCH 1969). Conard, Robert A.; Sutow, Wataru W.; Lowrey, Austin; (and others). (Brookhaven National Lab., Upton, N. Y.). 128p. Dep. CFSTI.

The results of medical surveys carried out during 1967, 1968, and 1969 on 67 people of Rongelap and Utirik Atolls who were exposed to fallout radiation during March 1954 are reported. An estimated dose of 175 rads of whole-body γ radiation, contamination of the skin sufficient to result in β burns, and slight internal absorption of radioactive materials through inhalation or ingestion was received by the people. A group of more than 100 Rongelap people, who were away from the island at the time of the accident, have served as a comparison population for the studies. The general health and development of the population is discussed and clinical findings are presented. The incidence of hypothyroidism and the high incidence of thyroid nodules and thyroid carcinomas in the population are discussed in relation to radiation exposure following absorption of fallout radioiodine (^{131}I, ^{132}I, ^{133}I, and ^{134}I) by adults and children. The incidence of thyroid carcinomas in the exposed population was 5.6% in comparison to 0.01% in the Marshalese population as a whole. Three cases of thyroid carcinoma are reported that were clearly associated with high levels of radioiodine exposure. A summary of findings from medical surveys of the population conducted over the previous 15-year period is included. (C.H.)

50799 (BNWL-1306(Pt.2)) PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1969 TO THE USAEC DIVISION OF BIOLOGY AND MEDICINE. VOLUME I. LIFE SCIENCES. PART 2. ECOLOGICAL SCIENCES. Vaughan, Burton E.; (and others) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jul 1970. Contract AT(45-1)-1830. 92p. Dep. CFSTI.

Separate abstracts were prepared for the three sections of this report. These sections are titled Environmental Studies, Terrestrial Ecology Studies, and Aquatic Ecology. (E.R.B.)

For abstracts of individual sections see: 50675, 50800, and 50801.

50800 (BNWL-1306(Pt.2), pp 1.1-19) ENVIRONMENTAL STUDIES. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1969, Vol. 1, Pt. 2.

Research activities during 1969 in the environmental studies section are reported. The thirteen projects reported on were concerned with the following areas: ecological micrometeorology and climatology of the ALE Reserve (4 reports); geology and paleoecology of the ALE Reserve (2 reports); hydrologic cycling on the ALE Reserve (3 reports); and characteristics of Hanford project soils (4 reports). The publications and presentations of the staff members during the reporting period are listed. (E.R.B.)

50801 (BNWL-1306(Pt.2), pp 2.1-31) TERRESTRIAL ECOLOGY STUDIES. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1969, Vol. 1, Pt. 2.

The research activities of the terrestrial ecology section during 1969 are reported. The 22 projects reported on were grouped as follows: terrestrial plant ecology (5 reports); terrestrial animal ecology (9 reports); mechanisms of transport and uptake of radio-

nuclides in Alaskan environment (2 reports); and mathematical simulation of radionuclide transfer and food chain processes (6 reports). The publications and presentations of the staff members during the reporting period are listed. (E.R.B.)

50802 (SZS-12/70) CONFERENCE OF THE GERMAN-POLISH WORK GROUP FOR THE SURVEILLANCE OF THE RADIOACTIVE CONTAMINATION OF THE ENVIRONMENT, BERLIN, JUNE 16-21, 1969. PART III. Moldenhawer, F.; Bose, H.; Korsets, B. (comps.) (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). May 1970. 50p. (In German). Dep. CFSTI (U. S. Sales Only).

A stationary monitor for environmental γ-radiation is described. It consists of two 5″ × 2″ sodium iodide crystals. A cross section of the equipment is depicted. Capability and efficiency of the instrument are demonstrated in seven figures and two tables. Effect of atmospheric turbulence on the time course of radioactivity is discussed. Mathematical equations are developed and their predictions are compared with experimental findings. Rapid methods for radiochemical determination of fission products are surveyed as to sampling, sample preparation, ashing or melting, dissolving, concentration, separation, activity measurement, and evaluation of results. Special emphasis is given to rapid determination of ^{137}Cs, ^{131}I, ^{90}Sr, ^{141}Ce, ^{144}Ce, ^{239}Pu, and fission product mixtures. (H.B.G.)

50803 CONTENT OF SOME CHEMICAL ELEMENTS AND RADIOACTIVE ISOTOPES IN MANURE SAMPLES FROM DIFFERENT REGIONS OF ARMENIA. Ananyan, V. L. (Inst. of Agrokhimiya Problem Gidroponiki, Erevan). Agrokhimiya; No. 10, 98-103(1968). (In Russian).

A comparison was made between manure collected at 10 different stations in Armenia and the hay used for animal feeding. With respect to Ca, Mg, Ba, Sr, Cu, K, Ra, ^{137}Cs, and ^{90}Sr, concentrations were higher in manure than in hay. In one ton of manure, the following concentrations were found in declining order: Ca, Mg, K, Ba, Sr, Ra, ^{137}Cs, and ^{90}Sr. With age of the manure, K and ^{137}Cs content decreased. Under the assumption that 20 tons of manure were plowed into one hectar of soil, the associated contamination with radioisotopes was assessed. (H.B.G.)

50804 MODIFYING EFFECTS OF ECOLOGICAL CONDITIONS ON THE GENETIC EFFECTS OF RADIATION IN THE DOMINANT INDICES AND SEGREGATION OF THE HYBRID WHEAT. Sadykhov, A. M. Izv. Akad. Nauk Azerb. SSR, Ser. Biol. Nauk; No. 4, 43-52(1968). (In Russian).

Gamma radiation effects as a function of the ecological conditions of cultivation of first and second generation wheat hybrids were studied using seeds irradiated with ^{60}Co γ rays of 10 and 15 kR at 343R/min doses for 29.6 and 43.4 min, respectively. The experiments were carried out in two different soil and climatic regions: the Karabach low-land of 420 m elevation with a moderately warm climate, and the Kel'badzhar of 2050 m elevation with cold and humid climate. The results revealed a significant dependence of γ radiation effects on the ecological conditions of cultivation. For instance in the Karakh low-lands the hybrid combinations, cultivated from γ-irradiation of seeds, resulted in an increased quantity of fuzzy forms while in the high-lands the result was quite in reverse. Also, as a result of γ irradiation of hybrid seeds and of the ecological effects various tendencies were observed in the changes of the dominant forms of the ontogenesis of plants. In the cases in which the first generation showed the prevalence of recessive forms the second generation showed the prevalence of the dominant forms. (R.V.J.)

50805 ACCUMULATION OF RADIOACTIVE ^{90}Sr BY MEADOW PLANTS UNDER SOIL CONDITIONS OF LATVIA. Shalaeva, T. V.; Miller, A. T. (Inst. of Biology, Riga). Latv. PSR Zinat. Akad. Vestis; No. 5, 20-3(1970). (In Russian).

The main factor influencing absorption of strontium-90 by meadow and pasture plants under climatic and soil conditions of Latvia is the amount of humus in soil. The role of soil acidity is less markedly pronounced. The largest amounts of radioactive strontium were found in the following plants: Trifolium pratense L., Phleum pratense L., Festuca rubra L., Carex inflata, Huds., the smallest in Sesleria coerulea (L.), Ard., Carex nigra (L.) Reichard. The characteristics of meadow vegetation as regards accumulation of strontium-90 remain unchanged under differing soil conditions. (auth)

Genetics and Cytogenetics

Refer also to abstracts 50705, 50712, 50764, 50804, 51015, 51102-51105, and 51107.

50806 (CONF-691106-6) EFFECTS OF WATER CONTENT, OXYGEN, AND METABOLIC STATE ON GENETIC EFFECT OF FAST NEUTRONS AND GAMMA RADIATION OF BARLEY SEEDS. Mikaelsen, K.; Kramer, J. (International Atomic Energy Agency, Vienna (Austria)). [nd]. 21p. Dep. CFSTI (U. S. Sales Only).

The barley varieties Union and Himalaya were used as experimental material for studying the effects of fast neutrons and γ radiation. The genetic effects were measured as chlorophyll mutation frequencies analyzed at the seedling stage of the M_2 generation. The doses of these experiments were selected on the basis of seedling growth tests that were carried out with the barley variety Himalaya, in the laboratory. Seeds were equilibrated to seed moisture content from 4 to 18% in the various experiments. The seeds were irradiated with fast neutrons in the Austria ASTRA reactor at Seibersdorf using a specially designed radiation facility, the so-called SNIF (Standard Neutron Irradiation Facility). A ^{60}Co radiation source was used for the γ radiations. Seeds equilibrated to 13% and 4% water content were treated with various doses of γ radiation (3 to 25 Krad) and fast neutrons (100 to 700 rad). The optimal dose for the highest mutation frequencies, which were approximately 1 to 12% (per cent mutations per 100 spikes), was obtained with both γ and fast neutron irradiations and at both seed moisture levels (13% and 4%). However, a higher M_2-mutant frequency was obtained by fast neutrons. The dose-mutation frequency relation was used to compare the effects of radiation and modifying factors. While water content of the seeds was highly significant in the genetic effects of γ radiation, no significant differences were found in the neutron-irradiated seeds with high (13%) and low (4%) water content. Experiments with treatments of oxygen and nitrogen following irradiations showed that this difference was, to a great extent, connected with oxygen effects in the γ irradiated seeds, while oxygen showed no influence on the genetic effect of fast neutrons. Presoaking the seeds at various lengths of time (from 4 to 24 hr) increased the sensitivity of barley seeds both to γ and fast neutron irradiation. When the presoaked seeds were redried to the original water content before irradiation, an increased radiosensitivity of the seeds that were soaked for 24 hr was found both with γ and fast neutron radiations. When the seeds were redried to 4% moisture content, a post radiation oxygen effect was found only after γ radiation but the size of this oxygen effect was much smaller than in seeds that were not soaked. (auth)

50807 (CONF-691212-, pp 425-30) CYTOGENETIC EFFECTS OF LOW-DOSE INTERNAL AND EXTERNAL RADIATIONS. Bloom, Arthur D. (Michigan Univ., Ann Arbor. Medical School).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8-11, 1969.

Diagnostic-level x irradiation is capable of inducing chromosome-type aberrations in human cells both in vivo and in vitro. Tissue-specific radionuclides, such as ^{226}Ra and ^{131}I, induce these aberrations in peripheral-blood lymphocytes over a wide range of dose levels. The cells of tissues in which these nuclides reside are also susceptible to the damaging effects from the alpha, beta, and gamma rays on their genetic material. The repeated epidemiologic finding of an association between radioactivity in a tissue and an increase in neoplasms of that tissue (as with bone tumors and radium and liver tumors and thorium) raises the possibility that chromosomal aberrations within the cells of a given tissue are related in some way to the malignant process. (auth)

50808 (COO-2001-2) GENTIC EFFECTS OF LOW X-RAY DOSES IN DROSOPHILA. Technical Progress Report, September 1, 1969-August 15, 1970. Abrahamson, Seymour; Meyer, Helen U. (Wisconsin Univ., Madison). Contract AT(11-1)-2001. 8p. Dep. CFSTI.

X chromosomes from oogonia of Drosophila melanogaster were tested for recessive lethal mutations using x radiation at doses of 500, 100, 20, and 0 (control group) R. The oogonial cells of adult virgin females were irradiated at about 70 R/min and F_1 offspring were tested for recessive lethal mutations as described previously. For these experiments, the term lethal was defined as a case where the frequency of males with the experimental x chromosome lies between 0 and 5% of the mean frequency found in control cultures with an obviously good viability of this class of males. Data are presented in tabular form for all experiments conducted to date. To date, the data do not encourage the assumption that the low x-ray mutability found for all gonial cells with higher doses in other experiments might be a consequence of selection against an especially radiosensitive stage of the gonial cell. Linear dose kinetics at very low doses (20 to 500 R) cannot at present be assumed for oogonial cells of Drosophila. (E.R.B.)

50809 (NP-18424) STUDIES ON PHYSICAL AND CHEMICAL MUTAGENESIS IN PLANTS. Mikaelsen, Knut (International Atomic Energy Agency, Vienna (Austria)). 1970. 30p. Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Univ. of Lund, Sweden.

The thesis surveys a series of investigations on genetic and cytogenetic effects of ionizing radiations, and the influence of certain factors which modify its effects in plants. Earlier published papers are reviewed, and data from unpublished work or papers in preparation are presented and discussed. (FHS) (SW)

50810 (NYO-2902-14) REPORT ON RESEARCH ON MUTATIONS TO SEX-LINKED LETHALS IN THE MOUSE, AUGUST 15, 1969-JULY 15, 1970. Caspari, Ernst W.; Eicher, Eva M. (Rochester Univ., N. Y.). Contract AT(30-1)-2902. 36p. Dep. CFSTI.

Males fd/Y were exposed to 250 R and 500 R x rays and mated to FCC (hybrid female C_3H pp X male CBA pp) females. Their litters were scored for sex, eye color, and litter size. Controls consisted of XY(+) males, mostly litter mates of the fdY males, irradiated in the same way, and litters of the same fd/Y male produced with the same females before irradiation. The total material consisted of 4,370 progeny from nonirradiated and irradiated animals. After irradiation with 500 R, the sex ratio from fd males rose from .58 to .67, close to the .05 level of significance. No similar change in sex ratio was obtained from +Y sibs (.53 vs .52). The size of litters produced by both fd and + males was significantly reduced after irradiation with 500 R. The sterile period after irradiation was increased in fd males as compared to + males, and many fd males did not return to fertility. In the poststerile period, litter size and sex ratio (in fd) rose again, significantly for the litter size of + males, but not of fd males. Five tumors developed in 16 fdY males, and one tumor in 15 +Y males. Six exceptional (pink eyed) females were found in 340 postirradiation young, and five exceptional females in 517 young conceived before irradiation. After irradiation with 250 R, the sex ratio did not increase in offspring from either fdY or +Y males. Litter size was reduced significantly in both fd and + and showed a tendency to rise in later litters. The fd males had a distinct poststerile period while + animals had no sterile period at 250 R. A tumor appeared in one of eight fd males, and in one of eight + males. Five exceptional females were produced in 341 postirradiation animals, and three in 320 animals before irradiation. The radiation effects observed were confounded by a breeding effect. It has been known that the fd chromosome becomes gradually lost when backcrossed to an inbred strain. This was the reason why fd females were bred to FCC males, since FCC is an F_1 hybrid. The data show that in four generations of backcrossing of fd females to FCC males, the mean litter size dropped from 5.86 to 3.71, and the proportion of fd offspring from 49% to 34%. A control experiment was carried out backcrossing fd to the inbred strain BALB/Cl. In this case, litter size dropped from 5.55 to 4.56 in six generations, but the proportion of fd progeny did not change significantly. The backcrossing effect is therefore not due to homozygosity or heterozygosity of the autosomal background, but may be related to the genetic constitution of the normal X chromosome, and possibly of the Xfd chromosome itself, as a result of crossing over with its normal homologue. The litter size produced by fdY males of different generations did not change significantly. The T6H translocation, involving LG III and an unknown LG, was investigated for its breakpoint in LG III, and the centromere position of LG III. The breakpoint is to the left of the gene s, the left-most known marker gene on LG III. The marker T6 reduces crossing over between s and hr. By use of the aneuploid condition 40 + T6, combined with s and hr it was shown that the s and hr loci are not located on the T6 marker. By the use of adjacent-2 segregation it was shown that the marker gene hr lies between the centromere and the breakpoint. The arrangement of genes in LG III is therefore centromere-hr-s-bp. (auth)

50811 MUTAGENIC ACTIVITY OF GIBBERELLIC ACID. [illegible]aryan, N. P. (Univ., Erevan). Genetika; 6: No. 9, [illegible]-40(Sep 1970). (In Russian).

Presowing treatment of seeds was used to study the physiological and mutagenic action of gibberelic acid and x rays. A mutagenic activity of gibberelic acid was established. The optimal duration of treatment and concentrations of gibberelic acid for all test species were determined. An advantage of gibberelic acid over x rays was demonstrated. Numerous analogous radioinduced and gibberelic mutant forms and strains were selected. Many of them possess decorative and economic qualities and are of practical value. (auth)

50812 MECHANISM OF RING-CHROMOSOME PRODUCTION AND SOMATIC CROSSING-OVER. Dubinin, N. P.; Nemtseva, L. S. (Inst. of General Genetics, Moscow). Genetika; 6: No. 9, 67-80(Sep 1970). (In Russian).

After ionizing irradiation of Crepis capillaris dry seeds, a new phenomenon of normal rod-shaped chromosomes, vested by ring chromosomes, was detected. Ring-chromosome production was connected with a radiation induced formation of a rigid loop by cross-links of different chromosome segments. The repair mechanism seems to cut DNA strands into three fragments at the cross-link site. When the spatially close fragment ends assume a definite position, the middle fragment forms a ring; the rejoined terminal fragments are within this ring which thus vests the chromosome. After cessation of DNA synthesis, two sister chromatids become vested by two sister rings. The appearance of different vesting patterns is associated with the somatic crossing-over between sister ring chromatids. At this moment, the internal chromatids appear to be capable of slipping out in different combinations from the rings vesting them. DNA strands are cut into fragments during both the production of chromosome rearrangements and somatic crossing-over. Due to the effect of chromosome repair cutting, chromosome rearrangements may result from exchange (contact of exchanging chromosomes, in a cross-link site), fragmentation mechanisms (when DNA molecules are cut without cross-links), or other mechanism assuring contact between different chromosome loci. (auth)

50813 ANTENNOPEDIX: A NEW HOMOEOTIC MUTATION IN DROSOPHILA MELANOGASTER. Stepshin, V. P.; Ginter, E. K. (Inst. of Medical Radiology, Obninsk, USSR). Genetika; 6: No. 9, 101-9(Sep 1970). (In Russian).

A new homoeotic mutation Antennopedix (Apx) in Drosophila melanogaster crossed with Berlin wide males irradiated with fast neutrons is described. Cytologically it is inseparable from chromosome rearrangement T(1;3) Apx = T(1;3)20D; 84B + In (3LR)79F; 84B. Map distances for the breaks involved are: in the 1st chromosome -66, and in the 3rd chromosome: left-46, and right-54. The Apx mutation is dominant showing 100% penetrance, and homozygous lethal. Apx males produce about 66% and Apx/+ females about 35% of unbalanced gametes. Phenotypical effects of Apx varies from appearance of some bristles on the 3rd antennal segment to a differentiation of a well developed homoeotic mesotoracal leg. The allelism of Apx mutation to Antp mutations and the action of Apx on the determination of the antennal imaginal disc are discussed. (auth)

50814 EFFECT OF γ-IRRADIATION OF THE RECIPIENT ON THE GENETIC RECOMBINATION IN ESCHERICHIA COLI K-12. Torosyan, M. V.; Rabinkova, E. V. (Inst. of Biophysics, Moscow). Genetika; 6: No. 9, 153-64(Sep 1970). (In Russian).

The effect of γ irradiation of the recipient F-AB 1157 and F-N12 on the yield of recombinants in the crosses was determined. When radiation dose increases, the number of the recombinants goes down. It was established that the slopes of the dose response curves for both proximal and distal markers depend on the donor used. The data obtained show that the impairment of the recombination process in crosses involving irradiated recipients occurs at the level of integration. When the Rec gene is present in the introduced segment of the chromosome, the slope of recombinants yield curve was found to decrease. γ-irradiation of the recipient has no effect on genetic constitution of the recombinants formed. (auth)

50815 INVESTIGATIONS ON THE PROCESS OF MUTATION INDUCTION BY ETHYL METHANESULFONATE IN BARLEY. Satpathy, Damodar. Saskatoon; Univ. of Saskatchewan (1969). 158p.

Thesis.

The effects of post-treatment temperature on the frequency of chlorophyll mutation in barley following treatment of seeds with 0.25% or 0.5% EMS solution were studied. It was established that mutation induction and fixation continued for more than 12 hours and possibly up to 24 hours after barley seeds were transferred from EMS solution to water for washing. Evidence for this was obtained by determining chlorophyll mutation frequencies in plants grown from different batches of seeds that had been treated in identical fashion except that they were subjected to different temperatures (10°, 20°, 30° or 40°C) during a 12- or a 24-hour washing period. Mutation frequencies were lowest after 10°C post-treatment temperature and they increased by factors of 1.4 to 2.5 with each 10°C step rise (to a maximum of 40°C), provided the initial frequencies were within 10 to 20% range. Very high rates of mutation (50% or more) were obtained by increasing post-treatment temperature from 10° to 40°C. Temperature variation during a 24-hour post-washing period produced larger effects on mutation rate than those obtained after a 12-hour period. Post-treatment periods of six hours, on the other hand, had lesser effects on the mutation rates than did the 12-hour periods. The maximum rate obtained in the experiments reported was 68.7% following treatment with 0.5% EMS for four hours at 30°C and posttreatment for 24 hours at 30°C. Mutation rates were apparently unaffected by post-treatment temperature following x-ray

treatment. The phenotypic expression of some chlorophyll mutations was found to be greatly influenced by temperature. Sixteen to 32% of segregating M_2 spikes produced M_4 seedlings with different mutant phenotypes under different temperature conditions. While all the albino mutants were stable, 12% of chlorinas, 37.5% of xanthas, 77% of bicolour mutants and 80% of tigrinas were found to be temperature-sensitive. Experiments with MMS confirmed the findings of earlier workers that this mutagen is very toxic to barley seeds and M_1 plants. The highest mutation frequency obtained was 13.3% following 0.2% MMS treatment for 4 hours at 20°C. Any increase in dose or temperature depressed the mutation rate and produced increased lethality. The mutation spectra induced by EMS and MMS (in comparable treatments) were very similar. Using EMS, x rays and γ rays it was found that chlorophyll mutation frequencies in the primary spikes of barley were generally higher than those in secondary spikes. But the mutant sector sizes showed the opposite trend. The ratio of mutant: green seedlings in the mutant spike progenies was 1.6 to 4.3 × higher in secondary than in the primary spikes. (auth) (F.M.M.)

50816 ULTRAVIOLET-SENSITIVE MUTANTS OF NEUROSPORA. I. GENETIC BASIS AND EFFECT ON RECOMBINATION. Schroeder, Alice Louise (Stanford Univ., Calif.). Mol. Gen. Genet.; 107: 291-304(1970).

Three new uv-sensitive mutants were obtained using replica plating of the colonial crisp ragged strain of Neurospora crassa—uvs-3 (near cys-10, linkage group IVL), uvs-4 (4 units left of ad-4, IIIR), and uvs-5 (<1 unit from vel, IIIR). These are genetically distinct from uvs-1 (Chang and Tuveson, 1967) and uvs-2 (IVR, Stadler and Smith, 1968). They are two to three times more sensitive to uv than wild type. Heterokaryons between any two mutations are not sensitive, showing that all three are recessive. In heterozygous condition, none of the mutants affects crossing over. In homozygous condition, uvs-4 does not affect gene conversion as measured by prototroph frequency in crosses of pan-2 (B2) × pan-2 (B36), nor does it affect crossing over between cot-1 and tryp-4. Neither uvs-3 nor uvs-5 is fertile in homozygous crosses; asci do not develop beyond the multinucleate ascogenous hypha stage. Mitotic effects were studied using strains haploid for uv-sensitivity but duplicated and heterozygous for mating type. In (ILR) H4250 and Tp(I → II) 39311 were used to generate such duplications. Release from a slow growing phenotype occurs when a mitotic event makes mating type homo- or hemizygous. With uvs-3, but not uvs-4 or uvs-5, release occurs 2 days earlier than in controls, thus uvs-3 may affect chromosome breakage or mitotic recombination. The number of chromosome rearrangements present in a sample of colonies grown from single conidia of uvs-3 stocks is the same as in controls, but in test crosses 13% of the colonies produced barren perithecia of a type that is characteristic of duplications. (auth)

50817 ULTRAVIOLET-SENSITIVE MUTANTS OF NEUROSPORA. II. RADIATION STUDIES. Schroeder, Alice Louise (Stanford Univ., Calif.). Mol. Gen. Genet.; 107: 305-20(1970).

Two new, recessive, chromosomal mutants of Neurospora, uvs-3, and uvs-4, were found to be more sensitive to uv than wild type. The uvs-3 mutant is very sensitive to nitrogen mustard nitrosoguanidine, and x-rays. UV-dose-response curves of uvs-3 lack the shoulder typical of wild type but parallel the wild type curve at low survival levels. Unlike wild type, which shows a decrease in survival when incubated in water or proflavine (4 mg/ml) after uv, uvs-3 shows an increase in survival after water incubation and an even greater increase when incubated in proflavine. It also differs from wild type in showing much less photoreactivation and in not losing its photoreactivation ability during two hours incubation in water. The uvs-4 mutant is not sensitive to nitrogen mustard and only slightly sensitive to nitrosoguanidine. Dose-response curves of uvs-4 retain a shoulder and are steeper than those of wild type at low survival levels. Proflavine sensitivity and photoreactivation of uvs-4 resemble wild type, but no decrease in survival occurs when it is held in water after uv. The combination of characteristics shown by uvs-4 is not like that of any of the uv, sensitive mutants found in Escherichia coli, but those of uvs-3 resemble those shown by the EXR (x-ray sensitive, low to normal recombination) and reckless REC (x-ray sensitive, recombinationless) mutant classes in bacteria. (auth)

50818 MUTAGENESIS IN ESCHERICHIA COLI. V. ATTEMPTED INTERCONVERSION OF OCHRE AND AMBER SUPPRESSORS AND MUTATIONAL INSTABILITY DUE TO AN OCHRE SUPPRESSOR. Bridges, Bryn A.; Dennis, Rachel E.; Munson, R. J. (Medical Research Council, Harwell, Eng.). Mol. Gen. Genet.; 107: 351-60(1970).

A possible quantitative system for the interconversion of ochre and amber suppressors was studied in Escherichia coli WU 36-10, a strain in which a leucine requirement is suppressed by amber suppressors and a tyrosine requirement is suppressed by ochre suppressors. The conversion of am Sup-2^+ to oc Sup-2^+ occurred at rates similar to those for the de novo induction of such suppressors, both spontaneously and after uv or γ. Both induction and conversion of suppressors showed the phenomenon of mutation frequency decline after uv. Conversions in the opposite direction from oc Sup-2^+ to am Sup-2^+ were, however, not detected in unmutagenised populations of oc Sup-2^+ strains derived either by conversion from an am Sup-2^+ strain or de novo from the parental WU 36-10, nor were they detected after treatment with uv, γ, or 2-aminopurine. If the conversion of oc Sup-2^+ to am Sup-2^+ occurs at all, it is at a rate lower than that for the conversion of am Sup-2^+ to oc Sup-2^+. Some Tyr$^+$ oc Sup-2^+ mutants demonstrated mutation rates c. 100 times greater than those of WU 36-10 for mutation to Leu$^+$ spontaneously and after uv or γ radiation. (auth)

50819 SUPERSENSITIVE DOUBLE MUTANTS IN YEAST. Khan, N. A.; Brendel, M.; Haynes, R. H. (York Univ., Toronto). Mol. Gen. Genet.; 107: 376-8(1970).

Double mutants containing the radiosensitive alleles uxs1 (UVR⁻EXR⁻) and either uvs1-2 or uvs1 9-2 (both UVR⁻EXR⁺) were constructed. These double mutants are extremely sensitive to uv: their LD_{37} doses are 0.3 to 0.5 ergs/mm² as compared to 16 to 40 ergs/mm² for the radiosensitive parental strains carrying only a single mutant gene and 456 ergs/mm² for wild-type. (auth)

50820 BILATERAL RENAL DYSPLASIA IN AN INFANT. Mazurek, Andrzej; Krzanowska-Dyras, Maria; Miezynski, Witold. Wiad. Lek.; 22: 1725-9(15 Sep 1969). (In Polish).

An infant with congenital bilateral renal agenesia is reported. Early clinical diagnosis was facilitated by the appearance of the child that was described in the literature as occurring in association with renal agenesia. The clinical course of the case was typical although not characteristic of the basic disease. In the search for the etiological factor of renal agenesia, the increased exposure of the mother—a nurse by profession—to x rays was considered. The possible development of this anomaly under the influence of generalized cytomegalic inclusion disease is discussed, since this disease was diagnosed on autopsy after histological examinations. (auth)

50821 SELECTION FOR SEXUAL ISOLATION IN DROSOPHILA MELANOGASTER BY A MODIFICATION OF KOOPMAN'S METHOD. Fukatami, A.; Moriwaki, D. (Tokyo Metropolitan Univ.). Jap. J. Genet.; 45: 193-204(Jul 1970).

The aim of the present study was to produce sexual isolation between two mutant strains, brown and ebony, of D. melanogaster with or without x-ray treatment. These two mutant strains were prepared in such a way as to have a nearly common genetic background before selection. A new selection procedure for the collection of the parents for the next generation, which is modified from that of Koopman, was applied. Four hundred flies in total, one hundred females and one hundred males of each of two mutant strains, were put into a population cage for 72 hours or into a population bell for 48 hours. Each female was isolated individually and allowed to lay eggs after the mating period and the type of mating was determined by the progeny test. On the average, about 20 percent of double matings were observed during 72 hours. Progenies for homogamic matings were selected as the parents exclusively. The proportion of females producing wild type progeny was taken as the measure of the sexual isolation. Regression coefficients of frequencies of females which produced wild type progeny in all four selected lines with x-ray treatment were negative, whereas three were positive in four selected lines without x-ray treatment. Selection for sexual isolation may be effective under the conditions of an effective procedure applied and with x-ray treatment producing gene mutations which affect mating preference. (auth)

50822 RELATIVE BIOLOGICAL EFFICIENCY OF 14.1 MeV FAST NEUTRONS AND ^{137}Cs GAMMA RAYS IN THE STAMEN HAIRS OF TRADESCANTIA REFLEXA RAFIN. Ichikawa, Sadao (Kyoto Univ.). Jap. J. Genet.; 45: 205-16(Jul 1970).

Inflorescences of Tradescantia reflexa (4x, 2n = 24) KU 7 clone which is heterozygous for flower color (blue/pink, blue being dominant) were irradiated acutely with 37 to 141 rads of 14.1 MeV fast neutrons and with 144 to 362 rads of ^{137}Cs gamma rays. The stamen hairs of the irradiated and control flowers were examined daily for 19 days after irradiation. At the time when the maximum radiation effects were observed, the average number of cells per hair, percentage of stunted hairs, postirradiation growth of hairs, pink mutant events per hair, percentage of pink mutant cells, and colorless events per hair were calculated for each dose and the effects of fast neutrons and gamma rays were compared. The

determined RBEs of 14.1 MeV fast neutrons as compared with ^{137}Cs gamma rays for the above six end points were 3.95, 3.50, 3.41, 5.05, 4.82, and 5.32, respectively. These RBE values are much lower than those usually obtained from higher plants (mostly dry seeds) and are closer to those from other organisms. This point is discussed with respect to water content and dose-rate effects. (auth)

50823 RELATIVE SPECIFICITY OF MUTAGENS FOR THE INDUCTION OF FORWARD MUTATIONS IN CORYNEBACTERIUM. Necasek, J.; Plachy, J. (Charles Univ., Roztoky, Czech. Inst. of Antibiotics and Biotransformations, Roztoky, Czech). Folia Microbiol. (Prague); 15: 275-81(1970).

Auxotrophic mutants of Corynebacterium sp. VUA 9366 used for industrial biosynthesis of some amino acids were induced by uv light and nitrogen mustard. The mutants were isolated by means of the penicillin technique. It was assumed when comparing mutation spectra after the treatment with both mutagens that the mutant cell gives origin to a clone of genetically identical cells; it was hence possible to express numbers of mutants as corresponding numbers of mutations. Requirements for vitamins, components of nucleic acids and amino acids were studied. It was found that mutations causing requirements for arginine which can be substituted by citrulline or ornithine, requirement for valine-isoleucine and components of nucleic acids are significantly more frequent after treatment with uv light. On the other hand, mutations leading to the requirement for arginine which can be substituted by citrulline were more frequent after treatment with nitrogen mustard. (auth)

50824 STUDIES ON MUTATION BREEDING OF RICE. Harn, C.; Kim, C. M.; Won, J. L.; Kim, Y. S. (Radiation Research Inst. in Agriculture, Seoul). J. Nucl. Sci. (Seoul); 10: No. 1, Pt. 2, 21-33(Jun 1970). (In Korean).

Several varieties of Korean rice were treated with various radiation sources (neutrons and x) and some desirable mutants were obtained. Frequency of chlorophyll mutations in R_2 generation was increased with increasing doses in all the lines, while in R_3 recurrent generation a tendency in frequency of chlorophyll mutations was not observed with the doses applied. The total number of mutants selected in R_2 generation and R_3 recurrent generation was 5017 lines. Among the short culm and early heading lines in R_4 generation of Palkweng, Hokwang, and Baikna No. 18, there were more than forty desirable lines which could be used directly as variety or as cross parent in hybrid breeding. (auth)

50825 RADIATION AND THE GREEN REVOLUTION. Isotop. Radiat. Technol.; 8: 96-101(Fall 1970).

Useful radioinduced mutations in plants up to July 1, 1969, are summarized in a table, with a brief introduction. (auth)

50826 EFFECTS OF GAMMA-RAYS ON GERMINATION, SEEDLING GROWTH, AND VIABILITY OF SOME RICE VARIETIES. Saha, C. S.; Jinahyon, S. (Kasetsart Univ., Thailand). Nucl. Sci. Appl., Ser. A; 5: 17-21(Apr 1969).

Investigations were carried out with four recommended rice varieties native to Thailand. The influence of γ rays on germinability, seedling height, root length, and viability was studied. From this study it was found that germination is a very poor criteria to measure the effects of radiation. Drastic reduction in survival was found above 40,000 rads. (auth)

50827 INDUCTION OF EARLY FLOWERING MUTANTS IN JUTE (CORCHORUS CAPSULARIS L. AND C. OLITORIUS L.). Mia, M. M.; Rahman, M. S.; Ali, S. M. (Atomic Energy Centre, Dacca, Pakistan). Nucl. Sci. Appl., Ser. A; 5: 10-16(Apr 1969).

Six mutants of the variety D-154 of Corchorus capsularis and five mutants of the variety C. G. of C. olitorius were isolated from the respective γ-irradiated populations. These were characterized on the basis of earliness in their flowering behavior. The mutants on the basis of earliness are classified into two groups—very early and early. The mean time of flowering in the very early types ranged from 22.6 ± 1.43 to 34.2 ± 1.14 days and that of the early mutants ranged from 58.0 ± 0.89 to 85.8 ± 1.03 days. The mutants were also studied for other characters such as height and diameter of the plants, node number at first flowering, pod number per plant, and number of seeds per pod. Cytological analysis of each of the mutants was made and details of the meiotic behavior of the chromosomes were observed. All evidences indicated that the early flowering mutants were the cases of true gene mutations. One of the mutants of C. capsularis that had a maturity period by a month earlier than that of the parent is considered in favor of its desired use after its yield performance is thoroughly evaluated. (auth)

50828 EFFECT OF IONIZING RADIATION ON TILLERING ABILITY, FLOWERING DATE, AND POLLEN STERILITY IN M_1 RICE. Saha, C. S.; Jinahyon, S. (Kasetsart Univ., Thailand). Nucleus (Karachi); 6: 217-20(Oct-Dec 1969).

The effect of ^{60}Co γ radiation on the tillering capacity, flowering date, and pollen sterility in the M_1 generation of four rice varieties from Thailand, Leuang Pratiew 123, Puang Nak 16, Chao Luang 11, and Gow Ruang 88 is reported. The first two show positive and the latter two negative correlation coefficients. In the case of Gow Ruang 88 there was a significant deviation from zero at 5% level of probability. The Gow Ruang 88 variety was the most radiosensitive in respect to pollen sterility. Generally, late flowering plants were seen in the irradiated populations, and a few dwarf plants in the irradiated populations flowered earlier than the control. (auth)

50829 ABILITY OF CHROMATID BRIDGES IN C. CAPILLARIS AND VICIA FABA TO DEVELOP DURING THE FIRST HOURS AFTER GAMMA IRRADIATION. Eliseenko, N. N.; Mitrofanov, Yu. A. (Inst. of General Genetics, Moscow). Radiobiologiya; 10: 404-8(May-Jun 1970). (In Russian).

Periodic fluctuation in cleavage of chromatid bridges was observed in the early hours after irradiation by comparing numbers of chromatid aberrations in metaphase, to the real number of bridges in anaphase. Bridge cleavage was maximal by 6 hrs and a minimal at 2 and 8 hrs after exposure. Caffeine modified radiation effect by increasing the strength of the chromatid structure comprising the bridge; chloramphenicol had a negligible effect. A nonrandom combination of proximal fragments was observed in isocentric chromosomes. (JPRS) (TSS)

50830 INACTIVATING AND MUTAGENIC EFFECTS OF SLOW PROTONS ON PHAGE T1. Troitskii, N. A.; Morozov, E. L.; Turbina, L. N. (Inst. of Genetics and Phytology, Minsk. Belorussian State Univ., Minsk). Radiobiologiya; 10: 446-50 (May-Jun 1970). (In Russian).

The inactivation and induction of h-mutations of phage T1 by slow proton irradiation in a channel ray tube were studied. It is proposed that inactivation of the phage is caused by the energy transmitted by the protons during the process of elastic nuclear collisions. The RBE for mutagenesis induced by slow protons is 18 times that for inactivation by uv. (JPRS) (TSS)

50831 MECHANISM OF THE FORMATION OF DOUBLE CLEAVAGES IN THE DNA MOLECULE OF PHAGES T2 AND λ IN γ IRRADIATION OF THEIR SOLUTIONS AND THE RADIOBIOLOGICAL ROLE OF THESE DAMAGES. Struchkov, V. A. (Inst. of Biological Phys., Pushchino, USSR). Radiobiologiya; 10: 323-31(May-Jun 1970). (In Russian).

The role of hydrodynamic shear in the mechanism of the formation of double cleavages was studied on irradiated solutions of phage DNA by the methods of sedimentation in a sucrose gradient and viscosimetry. It was shown that two types of double cleavages are formed in irradiated DNA: true (as a result of paired ionization) and shearing. The shearing double cleavages are formed from two single breaks (on opposite strands of DNA) at a distance of ~500 pairs of nucleotides from one another. It is proposed that such cleavages can arise during the replication of DNA and can be the main cause of radiation inactivation of viruses and cells. (tr-auth)

50832 COMPARISON OF THE EFFECTS OF LSD, HELIOTRINE, AND X IRRADIATION ON CHROMOSOME BREAKAGE, AND THE EFFECTS OF LSD ON THE RATE OF CELL DIVISION. Bick, Y. A. E. (Strangeways Research Lab., Cambridge, Eng.). Nature (London); 226: 1165-7(20 Jun 1970).

Comparisons were made of the effects of LSD, heliotrine, and x radiation on the induction of chromosome aberrations in cultured leukocytes from the marsupial Potorous tridactylus (rat kangaroo). Fully oxygenated blood was needed for the irradiation studies, and whole blood was irradiated at 25 R/min. With x irradiation only 5 to 7% of the total damage occurred in the heterochromation, whereas for heliotrine the values were up to 30% and for LSD up to 50%. As far as comparison was possible a dose of 100 R, at 25 R/min, produced damage corresponding to 4.2 μg/ml of LSD. This dose produced 0.0036 breaks/cell/R. (UK)

50833 EFFECTS OF LOW KILOVOLTAGE X RAYS ON CULTURED HUMAN PERIPHERAL LEUKOCYTES. Ciola, Benjamin (Univ. of Connecticut Health Center, Hartford). J. Dent. Res.; 49: 969-78(Sep-Oct 1970).

Cultured human peripheral leukocytes were irradiated with a beryllium window therapy machine. The data were subjected to an analysis of variance to determine if differences existed between amounts of exposure and time of exposure in the 72 hr culture

period. Additionally, the analysis was designed to determine if interactions existed between amount of exposure and time of exposure. A statistically significant linear trend of total aberrations was observed with increasing amounts of radiation at the 0.01 level. Time of irradiation had no effect on the total abberrations. (auth)

50834 SIZE AND APPEARANCE OF THE MUTATED SECTOR IN BARLEY SPIKES. Lindgren, Dag. (Skogshoegskolan, Stockholm); Eriksson, Goesta; Sulovska, Katarina. Hereditas; 65: 107-32(1970).

Dormant barley seeds were treated with γ-rays of EMS. Induced waxy mutations were studied in the first generation by analyzing the pollen grains anther by anther. In this way the chimeric pattern could be analyzed. The distribution of sector size was presented. The size varied between one single anther and the entire spike. Individual spikelets were frequently chimeric. Chimerism within spikelets occurred more frequently following EMS treatment than after γ-irradiation. The differences were probably due to the smaller size of the EMS-sectors. The chimerism within the spikelets was sufficiently widespread to have some influence on the segregation ratio. The ways of estimating mutation frequencies were discussed. The mutation frequency measured in the second generation might be somewhat underestimated, especially in main spikes and after EMS treatment owing to chimerism within spikelets. The distribution of sizes of sector was calculated based on the distribution of segregation ratios for chloroplast mutants. The results are in accordance with those obtained for the waxy mutants. The probability that two seeds chosen at random or in certain positions from a main spike containing the same mutant gene was calculated. The number of initial cells in a seed corresponding to the male germ line of a barley main spike was around three. (auth) (SW)

50835 GENE-CONTROLLED RADIATION SENSITIVITY OF YEAST. VII. IDENTIFICATION OF THE GENES FOR THE X-RAY SENSITIVITY. Suslova, N. G.; Zakharov, I. A. (Ioffe Inst. of Physics and Tech., Leningrad). Genetika; 6: No. 8, 158-63(Aug 1970). (In Russian).

Thirteen x-ray sensitive mutants were isolated and studied in yeast Saccharomyces cerevisiae. Genetic analysis revealed five genes for x-ray sensitivity designated xrs_1, xrs_2, xrs_3, xrs_4, xrs_5. Mutation to uv sensitivity uvs_2 does not change the resistance to x ray. The x-ray sensitivities of the haploids bearing mutations $xrs_1 - xrs_5$ are not different. These mutants have higher sensitivity than the wild type haploid only when irradiated with higher doses. (auth)

50836 EFFECT OF CUPFERRON ON RECOVERY FROM RADIATION DAMAGE IN TRADESCANTIA MICROSPORES. Davis, Herbert L. Jr. (Emory Univ., Atlanta). Contract AT(40-1)-2669. Radiat. Bot.; 10: 191-8(Apr 1970).

Cupferron was used to determine its effect on the frequency of x-ray induced chromosomal aberrations in microspores of Tradescantia paludosa. Inflorescences were given pre- and post-irradiation treatment in various concentrations of cupferron in conjunction with a total dose of 400 rads of x radiation delivered in a helium atmosphere. Concentrations of cupferron of 10^{-2} molar or greater proved to be toxic but did not produce any radiomimetic effects in the form of chromosomal aberrations. Pre-treatment or post-treatment with cupferron resulted in a reduction of the number of chromosomal aberrations. Treatment with cupferron in a helium atmosphere demonstrated that its effectiveness in reducing chromosomal aberrations decreased as the period of anoxia increased. The effects of cupferron on cellular respiration are discussed along with the recovery system in Tradescantia microspores. (auth) (UK)

50837 A CLONAL ANALYSIS OF DETERMINATION IN ANTENNAPEDIA A HOMOEOTIC MUTANT OF DROSOPHILA MELANOGASTER. Postlethwait, John H.; Schneiderman, Howard A. (Case Western Reserve Univ., Cleveland). Proc. Nat. Acad. Sci. U. S.; 64: 176-83(Sep 1969).

The process by which cells select one of several specific programs of genetic information in development was examined in homoeotic mutant Antennapedia of Rappaport in Drosophila melanogaster. The results show that the alteration of determination from antenna to leg induced by this homoeotic mutation occurs in a population of cells related by proximity rather than by pedigree. Clones of cells marked by means of x-ray-induced somatic crossing-over prior to early third instar participated in the formation of both antenna and homoeotic leg, but after this time, the clone was restricted to either antenna or homoeotic leg, indicating that determination occurs in the third larval instar. The results are discussed in relation to other processes of determination. (auth)

50838 NON-UNIFORM RADIOSENSITIVITY OF THE DORMANT ROOT MERISTEM OF BARLEY SEED REVEALED BY CHROMOSOME ABERRATIONS IN CELLS AT METAPHASE OF THE FIRST DIVISION CYCLE. Savage, John R. K.; Wigglesworth, D. J. (Medical Research Center, Harwell, Eng.). Radiat. Bot.; 10: 377-90(Jul 1970).

It is generally assumed for radioinduced chromosomal aberration studies, that the dormant root meristem of seeds has a uniform radiosensitivity with respect to time. Therefore, provided that only cells in the first division cycle are scored, the effects of differential delay and cell mixing, that are also produced by radiation, can be disregarded. Details of experiments are given designed to test the validity of this assumption for seeds of barley (Hordeum vulgare). A single dose of 40 krad of ^{60}Co γ radiation was given to dormant seeds (~10 per cent moisture) that, together with unirradiated controls were soaked immediately in aerated distilled water, and germinated on filter paper in a constant environment at 21.5°C. Fixations were made every 3 hr from 15 to 48 hr from the start of soaking, some seeds receiving no colchicine prior to fixation, others a 3 hr colchicine treatment, and a third lot continuous colchicine, from 12 hr post-soaking until the conclusion of the experiment. Various parameters were scored to examine the perturbations produced by radiation in the cell population, and at the same time, detailed scores of chromosome-type aberrations at metaphase in diploid cells were made. It is shown that at least for low LET radiations, the dormant meristem cannot be regarded as a homogeneous cell population, and the assumption of a uniform radiosensitivity with respect to time is invalid. It follows that no single post irradiation fixation time can give a reliable estimate of aberration yield, and that any treatment of the seed, either pre or post irradiation, that will perturb the orderly progression of meristem cells, will also change the observed pattern of response, rendering the assessment of comparative effects almost impossible. (auth) (UK)

50839 DUPLICATIONS INDUCED BY IRRADIATION OF FEMALES OF DROSOPHILA MELANOGASTER. Mglinets, V. A.; Semenova, V. A. (Inst. of Medical Radiology, Obninsk, USSR). Genetika; 6: No. 8, 86-94(Aug 1970). (In Russian).

Two to 3 day old females of Drosophila melanogaster were γ irradiated (4000 R) and mated to In(1) sc^1 · AM sc^1 males. Among 1108 cytologically studied larvae F_1 55 chromosomal aberrations were found, including 32 inversions, 15 duplications and 4 translocations. A classification of duplications is given, and the pattern of salivary gland chromosomes pairing in individuals heterozygous for duplications is described. Trivalent formation in a duplicated segment is found to be peculiar to the process of pairing. The mechanism of duplication formation and its role in the evolutionary process is discussed. (auth)

50840 ON CORRELATION BETWEEN ANEUPLOIDY AND OTHER EFFECTS OF IRRADIATION. I. CHROMOSOME MUTATIONS. Semenova, V. A.; Mglinets, V. A.; Glotov, N. V. (Inst. of Medical Radiology, Obninsk, USSR). Genetika; 6: No. 4, 165-9(Apr 1970). (In Russian).

Females of Drosophila melanogaster, strain yw were γ-irradiated and mated to In(1) sc^1 + AM, sc^1 males. Females XX and XXY and males XY and XO were distinguished among F_1 larvae on the basis of differences in pigmentation (chaetae, oral apparatus, and Malpighian tubes). The correctness of this larval stage diagnosis was checked on cytological preparations of a giant chromosome is salivary glands, and then the frequencies of chromosome mutations were scored. The results were as follows: in XX females —3.8%, XY males —3.8%, XXY females —21.8%, and XO males —4.5%. None of the 13 chromosome mutations in XX females involved X-chromosome while 7 to 12 mutations in XXY females did. Thus, certain chromosome aberrations (that do not cause the elimination of X-chromosome, though often involving it) increase the probability of chromosome non-disjunction. (auth)

50841 IDENTIFICATION OF HUMAN CHROMOSOMES, INVOLVED IN THE FORMATION OF DICENTRICS AFTER IRRADIATION. Bochkov, N. P.; Kuleshov, N. P.; Sergeev, A. S.; Yakovenko, K. N. (Inst. of Medical Genetics, Moscow). Genetika; 6: No. 4, 179-85(Apr 1970). (In Russian).

The leukocytes of peripheral blood of three adult healthy men were irradiated by x rays (at a dose of 92 R). The time of cultivation was 54 hours, thus the metaphases of the first postirradiated mitosis were investigated. A karyotypical analysis of cells with dicentrics was carried out. The experimental frequency of the involvement of the chromosomes in the formation of dicentrics is different from the theoretical in accord with the length of chromosomes and their numbers. The chromosomes of D and E' groups are involved more frequently while the chromosomes of G group are involved more rarely than it could be predicted according to the length of chromosomes. The involvement of chromosomes in

dicentrics is not random. The dicentrics, consisting of chromosomes C and E; D and D, E' and E; F and G occur more frequently compared with theoretical data while the dicentrics from the chromosomes 1 and 1, C and G occur more rarely. The discrepancy of experimental and theoretical data is explained by a different distribution of the chromosomes in the interkinetic nucleus. (auth)

50842 MUTAGENIC EFFECT OF DIFFERENT TYPES OF RADIATION ON SPERMATOGONIA IN MICE. V. THE MUTAGENIC EFFECT OF SINGLE AND FRACTIONATED IRRADIATION BY FAST NEUTRONS ON SPERMATOGONIA. Domshlak, M. G.; Pomerantseva, M. D.; Ramaiya, L. K. (Inst. of General Genetics, Moscow). Genetika; 6: No. 8, 79-85(Aug 1970). (In Russian).

The mutagenic effect of fast neutrons (1.5 MeV) administered in single and fractionated doses on spermatogonia of male mice was studied. The frequency of reciprocal translocations and the yield of dominant lethal mutations were used as criteria. Translocations were determined cytologically in the spermatocytes at the diakinesis-metaphase stage of the first meiotic division. The full doses were 100 and 216 rad. The dose of 100 rad was administered as a single dose to the male mice and in 8 (12.5 rad × 8) fractions with 14 days intervals between the exposures. The dose 216 rad was administered as a single dose and in 2 fractions (108 rad × 2) with 24 hours and 28 days intervals between the exposures and in 3 fractions with 28 days (72 rad × 3). It was shown that the mutation yield was higher in the case of fractional exposures than in the case of single exposure. The difference in the mutation rate between the single and fractional exposures is more significant in the case of full dose 216 rad, than in the case of the full dose 100 rad. It seems likely that this phenomenon can be attributed to the decrease by fractionation of the full dose of selective elimination of the more mutation-sensitive cells in the spermatogonial population. From these experiments the possibility of accumulating mutations by repeated irradiation is shown. (auth)

50843 GENETIC ADAPTATION OF CHLORELLA POPULATIONS TO CHRONIC EFFECT OF IONIZING RADIATION. Shevchenko, V. A. (Inst. of General Genetics, Moscow). Genetika; 6: No. 8, 64-73(Aug 1970). (In Russian).

The experimental results of the chronic irradiation influence employing radionuclides $^{90}Sr + ^{90}Y$ on alterations of the radioresistance and viability of natural populations of Chlorella vulgaris were described. It was shown that combination of the selection and mutation pressure of Chlorella populations under conditions of high $^{90}Sr + ^{90}Y$ concentration in the soil resulted in an increase of the level of mutant specimens in populations irradiated over the control. Seasonal cyclic changes at this level were established. In experiments on x-ray resistance of isolated strains, a higher radioresistance of the Chlorella populations, grown under conditions of increased radioactivity of the medium, was observed. LD_{50} during the x-ray irradiation of strains isolated from the sites of high $^{90}Sr + ^{90}Y$ concentration was about 1.5 to 2 times higher than in strains of the control population. In this case there was an optimal $^{90}Sr + ^{90}Y$ concentration for selection on the radioresistance in the medium. At the radioactivity levels exceeding the optimal, a decrease of the population radioresistance was observed. Under conditions of high $^{90}Sr + ^{90}Y$ concentration in the soil, there occurs a nonspecific selection of more viable forms as compared with control populations. Radioresistant strains of Chlorella are more thermoresistant as compared with control populations. The average index of growth rate of radioresistant strain cells in the exponential growth phase is 16% higher than in the control. Specific productivity of radioresistant strains on the average is 27.4% more than specific productivity of control population strains. (auth)

50844 EFFECT OF DOSAGE RATE OF X-RAYS ON THE CHROMOSOME DAMAGE IN DORMANT SEEDS OF CREPIS CAPILLARIS. Kraevoi, S. Ya.; Khalikov, P. Kh.; Nemtseva, L. S.; Romanov, V. P. (Inst. of General Genetics, Moscow). Genetika; 6: No. 8, 59-63(Aug 1970). (In Russian).

The effect of different dosage rates of x rays on the frequencies of chromosomal aberrations in dormant seeds of Crepis capillaris was studied. At irradiation of moistened (70 to 80% water) seeds, the chromosome damage increased with dosage. At irradiation of dry (2 to 3% water) seeds, the chromosome damage varied inversely with dosage rate. (auth)

50845 MODIFICATIONS OF THE MUTAGENIC EFFECT OF ETHYLENIMINE AND GAMMA-RAYS UNDER DIFFERENT METABOLIC CONDITIONS AT THE NORMAL GERMINATION OF CREPIS CAPILLARIS SEEDS. Dubinina, L. G. (Inst. of General Genetics, Moscow). Genetika; 6: No. 8, 35-53(Aug 1970). (In Russian).

Crepis capillaris seeds subject to normal germination and post-treatment with ethylenimine at different times of growth manifested regular modifications in the mutation frequency. The maximal mutability was observed for dry seeds and for those 1, 2, 3, 4 h after soaking. There was a sharp fall-off in the mutation frequency for 5 h growth and the second maximum was for 15 h with marked reduction for 30 h growth. Chromosome-type mutations resulted from the treatment of dry seeds and seeds growing during 4 h from the beginning of soaking. After 5 h growth, chromosome-type mutations practically disappear. The radiation analysis of stages of the cellular cycle in the first mitosis during seed germination showed that in dry seeds after 5 and 10 h growth the exposure to radiation gives rise to chromosome-type rearrangements, i.e., during this time the nuclei of cells are in G_1. First chromatid mutations arise 16 h after the beginning of seed soaking, the maximum is seen at 18 h. It is suggested that loss of ability for chromosome-type mutation production has no direct relation to the progress through the cellular cycle. This is the main difference between mutagenesis induced by alkylating agents and radiation mutagenesis whereby the type of chromosome rearrangements completely depends upon the phase of the cell nucleus. Early G_1 and the synthetic phase are most sensitive to ethylenimine treatment. The synthetic phase is most sensitive to radiation. (auth)

50846 EFFECTS OF RADIATION ON MUTABILITY FACTORS IN WHEAT. Novy, Jaroslav; Urban, Jan; Petrovic, Jan. Biologia (Bratislava); 25: No. 1, 19-26(1970). (In Czech).

Single and fractionated doses of radiation were administered to winter wheat. The following characteristics were analyzed for components of variability: number and weight of ears, number of grains per ear, weight of grains per plant, and weight of 1000 grains. Results varied with radiation dose and correlation coefficients characterizing the degree of heritability were also influenced by radiation dose. (auth)

50847 AN APPROACH TO THE STUDY OF GENETIC EFFECTS FROM THE $^{14}N(n,p)^{14}C$ REACTION FOR THERMAL NEUTRONS. Ecochard, R. (EURATOM-ITAL, Wageningen, Netherlands). Int. J. Radiat. Biol.; 17: 439-48(1970).

The genetic effect of the nuclear reaction $^{14}N(n,p)^{14}C$ was evaluated in a tomato cross; dry pollen with a known chemical composition was exposed to a thermal neutron flux of 4.1×10^7 n cm^{-2} sec^{-1} plus 11.6 rads/h gamma contamination. For this purpose plants were fed ^{15}N in place of ^{14}N from the beginning of growth. For seven criteria of radiosensitivity (reduction in seed-set and mutation frequencies in F_1) the radiation effect was reduced by half to two-thirds as a consequence of this change. As the second capture reaction, $^{10}B(n,\alpha)^7Li$, was similarly controlled in the same material, the degree of genetic effect of both reactions could be compared. They were found to be independent and additive, the nitrogen capture reaction being the more important, partially because of a larger effect per rad. The gamma component of the beam also provided a basis for an estimation of RBE. This would lie, for the ^{14}N reaction, in the neighborhood of 1.5 to 3.0 in the present conditions. (auth) (UK)

50848 INFLUENCE OF BUdR INCORPORATION INTO S_d PHAGE DNA ON THE LETHAL AND MUTAGENIC EFFECTS OF UV-IRRADIATION. Tikhomirova, L. P. (Inst. of Molecular Biology, Moscow). Mol. Biol. (Moscow); 4: 129-36(1970). (In Russian).

When thymine in the DNA was substituted by BUdR lethal and mutagenic effects of uv light on the virulent phage s_d were studied. Premutational lesions of this phage are not repaired by the host cells (E. coli CK). It was found that almost complete substitution results in a high uv-sensitivity of the phage. Neither the uv-initiated mutagenic effect nor the uv-induced mutation spectrum were affected, however, the maximum of the uv-induced mutations of the BUdR-phage was significantly shifted to greater lethality. On the basis of the results obtained as well as the literature data it is concluded that in some other systems (bacteria, temperature phages) the enhancement of the mutagenic effect of uv irradiation is due to inhibition of the repairing of premutational lesions in BUdR-DNA, BUdR-photoproducts being not mutagenic. (auth)

50849 STUDY ON CHLOROPHYLL MUTATION SPECTRUM BY CHEMICAL PROTECTION AGAINST GAMMA-RADIATION IN BARLEY. Levenko, B. A. (Inst. of Botany, Kiev). Genetika; 6: No. 8, 24-34(Aug 1970). (In Russian).

The effect of soaking barley seeds in solutions of some chemicals before treatment with γ rays on the chlorophyll mutation spectrum in M_2 was studied. Seeds of two spring distichous barley varieties were soaked in 0.005 and 0.05 M solutions of thiourea cysteine and ferrous chloride, seeds of winter hexastichous barley were soaked in 0.01, 0.05 and 0.1 M solutions of cysteine and thiourea. Then the seeds were irradiated with 10 and 20 kR

doses (7.5 and 15 kR in one spring barley variety). The spectrum of chlorophyll mutation widened with increase of irradiation dose. The number of mutation types in most variants with chemical treatment of spring barley seeds before high doses of irradiation exceeded those after control soaking of barley seeds in water before irradiation. The close shift of the chlorophyll mutation spectrum, induced by irradiation, by the action of chemicals in spring barley varieties in comparison with winter barley reaction is shown. (auth)

50850 DOSE-RESPONSE CURVE FOR X-RAY-INDUCED TRANSLOCATIONS IN MOUSE SPERMATOGONIA. II. FRACTIONATED DOSES. Morris, T.; O'Grady, S. E. (Medical Research Council, Harwell, Eng.). Mutat. Res.; 9: 411-15(Apr 1970).

When x-ray doses to mouse spermatogonia were split into 2 equal fractions 24 hrs apart the incidence of translocations in spermatocytes increased approximately linearly with dose from 100 to 1400 rad. In contrast to Russell's results with gene mutation, there was no evidence of enhancement of translocation incidence by fractionation. It is therefore suggested that the stage at which the cells were synchronized by the first radiation dose was one highly sensitive to gene mutation but not abnormally sensitive to chromosome damage, and that this is in line with work on mutational processes in other organisms. From the results of the 100 rad dose and from other work it is suggested that repeated low doses may change the spermatogonial population so as to make it more resistant. (auth)

50851 DOSE-RESPONSE CURVE FOR X-RAY-INDUCED TRANSLOCATIONS IN MOUSE SPERMATOGONIA. I. SINGLE DOSES. Savkovic, N. V. (Boris Kidric Inst. for Nuclear Science, Belgrade); Lyon, M. F. Mutat. Res.; 9: 407-9(Apr 1970).

Male mice were given single doses of x rays during first meiotic metaphase and were examined 8 or more weeks later. The incidences of cells with translocations after doses of 500 to 800 rad were 12.2, 14.0, 14.2, and 6.8% respectively. This humped dose response curve is in good agreement with other work. (auth)

50852 RBE VALUES OF 15-MeV NEUTRONS FOR RECESSIVE LETHALS AND TRANSLOCATIONS IN MATURE SPERMATOZOA AND LATE SPERMATIDS OF DROSOPHILA. Sobels, F. H.; Broerse, J. J. (Univ., Leiden. Radiobiological Inst. TNO, Rijswijk, Netherlands). Mutat. Res.; 9: 395-406(Apr 1970).

Frequencies of sex-linked recessive lethals (in the X^{C2} chromosome) and of translocations between the second and third chromosomes in Drosophila melanogaster were determined after irradiation of mature spermatozoa and late spermatids with 15-MeV neutrons and 250-kV x irradiation. The doses employed ranged from 1200 to 4000 rad. The results show that, at all dose levels, neutrons are more effective than x-rays in producing genetic damage in late spermatids than in mature spermatozoa. The effect is more pronounced for translocations than for recessive lethals; at translocation frequencies of 2 to 4%, neutrons are about twice as effective in spermatids as in sperm. These observations are consistent with the finding that the lower sensitivity of late spermatids to x irradiation originates from their lower degree of oxygenation than sperm. The greater effectiveness of neutrons in producing chromosomal damage in these relatively anoxic cells, is therefore another indication of the potential advantage of neutrons over x-rays in the treatment of tumors. The relatively low RBE values obtained for 15-MeV neutron irradiation are discussed in the context of what was recorded in the literature. The apparent discrepancies between the present and the earlier results seem to arise both from a possible mixing of stages with different x-ray sensitivity and from using neutrons of different LET spectra in the earlier work. (auth)

50853 INDUCTION OF DELETIONS IN X-CHROMOSOMES OF DROSOPHILA. Falk, Raphael (Hebrew Univ., Jerusalem). Mutat. Res.; 10: 61-6(Jul 1970).

A mating scheme was designed in Drosophila to assay nearly whole X-chromosome deletions, having one break in the proximal euchromatin end of the chromosome and the other in the distal end. The frequency of deletions induced by x rays in spermatozoa with attached X · Y chromosomes was twice that in regular rod X-chromosomes. The increase could be due to the availability of more potential sites for breakage in the heterochromatin. The 7-10 times higher frequency of deletions detected in the ring X-chromosome is decisively more than expected from the availability of potential breakage sites, especially when the elimination of deletions by torsional rejoining is considered. It is proposed that the higher probability of the two broken ends of the ring chromosome being within effective distance for rejoining than the ends of the rod chromosomes has contributed to this result. Non-random segregation of attached X · Y gametes led to spuriously high recombination frequencies between maternal markers. (auth)

50854 INDUCED RECESSIVE LETHALS IN THE RING X-CHROMOSOME OF DROSOPHILA. Falk, Raphael (Hebrew Univ., Jerusalem). Mutat. Res.; 10: 53-60(Jul 1970).

Fractional recessive lethals were induced twice as frequently in a ring X-chromosome as in a rod X-chromosome, both in irradiated spermatozoa and in irradiated early spermatids. This leads to the conclusion that x ray induced fractional lethals are mainly the result of breakage rejoining processes and that under corresponding conditions the involvement of the ring X-chromosome in such processes is more frequent than that of the regular rod X-chromosome. The agreement between the frequencies of whole body recessive lethals induced by x rays in spermatozoa in the two types of chromosomes is due to the net result of more rearrangement induction as well as of more elimination of rearrangements in the ring than in the rod. The differences between fractional mutations induced by ethyl methane sulphonate in the rod and the ring chromosomes are that they are much smaller, as may be expected from this mutagen which induces predominantly point mutations which are not eliminated by torsional rejoining in the ring. The excess of potential lethals in the ring is mainly the result of increased breakage-rejoining in the terminal euchromatic segments, next to the heterochromatin. This is chiefly due to the additional heterochromatin in the ring which presents more sites where breakages may occur, but it may also be a manifestation of a position effect causing nearby euchromatic segments to be more susceptible to rearrangement production. This is shown by the somewhat higher frequency of induced recessive lethals in two attached X · Y rod chromosomes than in the regular rod X-chromosome and by the higher proportion of recovered lethals that are located in the most proximal euchromatic segment in the ring-X and in the two attached X · Y rods than in the regular X-chromosomes. (auth)

50855 STUDIES ON THE MUTABILITY OF ESCHERICHIA COLI K12. II. MODIFICATION OF RADIATION SENSIVIVITY BY REVERSIONS IN A THREONINE AUXOTROPH. Kada, T. (National Inst. of Genetics, Mishima, Japan. Inst. of Physical and Chemical Research, Saitama, Japan). Mutat. Res.; 10: 103-9 (Aug 1970).

Reversions in a threonine auxotroph of Escherichia coli K12 TH 1014 were due to suppressions involving mod and fgr loci. Large numbers of the descendants from revertant colonies showed increased sensitivities to uv irradiation or γ-rays and formed filamentous cells in the course of post irradiation incubation. Reversions caused no modification in the host-cell reactivation capacity. These revertants were as sensitive to irradiation as E. coli B, whereas the parent auxotroph had a radiation resistance similar to that of E. coli B/r. Studies on several F^- strains carrying differently constructed mod and fgr genes indicated that the genetic character mod^+ fgr^+ was required to manifest the marked increased radiation sensitivity accompanying filamentation. The above observations showed an example in which common suppressor gene(s) function both in auxotrophy and filamentation. (auth)

50856 RECESSIVE LETHALS INDUCED BY NITROUS ACID IN ASPERGILLUS NIDULANS. Azevedo, J. L. (Univ., Sao Paulo, Brazil). Mutat. Res.; 10: 111-17(Aug 1970).

The frequency of spontaneous and nitrous acid-induced irreparable recessive lethal mutations was estimated in a diploid strain of Aspergillus nidulans. Markers on at least one member of each chromosome pair permitted the assay of lethals in all 16 chromosomes of the diploid strain. 50 treated isolates produced 4 lethals giving a frequency of 8% induced lethals for the whole genome at 5% survival. One isolate was heterozygous for 2 non-allelic lethals in trans. After treatment with uv it produced a stable heterokaryon which was balanced by the non-allelic lethals, one on each haploid component. Meiotic and mitotic analysis showed that uv treatment has caused a translocation, to chromosome V, of a segment of a chromosome III carrying one recessive lethal and also the wild-type allele of the second lethal. (auth)

50857 NONDISJUNCTION INDUCED BY X-RAYS IN OOCYTES OF DROSOPHILA MELANOGASTER. Traut, H. (Univ., Muenster, Ger.). Mutat. Res.; 10: 125-32(Aug 1970).

The dose dependence of the frequency of X-chromosomal nondisjunction induced by x rays in immature oocytes of Drosophila melanogaster was investigated with emphasis on the relatively low dose range (0-1000 R). Our large scale experiments (nearly 600,000 flies analysed) show that there is no continuous increase in nondisjunction frequency up to 1000 R. However, a statistically highly significant rise of the dose-effect curve from 1000 R to

1800 R was observed. Our results may be considered as evidence that the dose-effect relationship of nondisjunction induced by x rays in immature oocytes of D. melanogaster is characterized by a threshold dose of about 1000 R. The possible significance of our finding with respect to recent reports on the correlation between somatic nondisjunction and human carcinogenesis is discussed. (auth)

50858 X-RAY-INDUCED DOMINANT LETHAL MUTATIONS IN MALE GUINEA-PIGS, HAMSTERS, AND RABBITS. Lyon, Mary F. (Medical Research Council, Harwell, Eng.). Mutat. Res.; 10: 133-40(Aug 1970).

The yields of dominant lethal mutations in successive post meiotic stages after x ray doses to male guinea pigs, rabbits, and hamsters were compared with those after a similar dose to mice, by dissecting females pregnant by irradiated males and counting corpora lutea and live and dead embryos. After 500 rad x rays guinea pigs and rabbits both gave a lower yield of dominant lethals than mice, but they showed a similar pattern of relative sensitivity of germ cell stages, with spermatids more sensitive than mature spermatozoa. Hamsters, after a dose of 200 rad, gave a yield of dominant lethals from mature spermatozoa nearly as high as after 500 rad to mice, but the pattern of sensitivity was different, with nearly mature sperm and spermatids giving a lower yield, close to that expected after 200 rad to mice. Thus, in extrapolating from species to species account must be taken of different patterns of relative sensitivity of germ cell stages as well as of overall differences in sensitivity. (auth)

50859 MUTAGENESIS OF CULTURED MAMMALIAN CELLS BY X-RADIATION AND ULTRAVIOLET LIGHT. Bridges, B. A.; Huckle, Jean (Medical Research Council, Harwell, Eng.). Mutat. Res.; 10: 141-51(Aug 1970).

The mutation of cultured Chinese hamster cells to 8-azaguanine resistance was studied after ultraviolet and x irradiation. Optimum numbers of induced mutants appeared after an expression time of 30 to 40 hrs. before the addition of 8-azaguanine, and the yield of mutants tended to decrease when the initial number of cells in a 9 cm diameter plate exceeded 10^5. There was some evidence consistent with the hypothesis that cells resistant to 8-azaguanine are at a disadvantage at high cell densities in the absence of 8-azaguanine. An incubation period of at least 10 days after the addition of 8-azaguanine was necessary to detect the maximum number of induced mutants. Dose response curves after exposure to uv light were linear in contrast to cumulative type curves obtained after x irradiation. A comparison of induced mutation rates for various species and cells after ionizing irradiation shows that the high mutability of animal cells compared with microorganisms does not appear to be correlated with the presence of meiotic stages but may be a general property of animal cells. The high mutability per unit dose of ionizing radiation, although not totally incompatible with a theory of DNA located primary damage, could indicate that the target is large, for example, a lysozome which when hit releases DNA damaging enzymes through the nucleus. The results are discussed in terms of possible mechanisms and of the suitability of the system for routine mutagen screening. (auth)

50860 GENETIC CLASSIFICATION OF THE LETHAL EFFECTS OF VARIOUS AGENTS ON HETEROKARYOTIC SPORES OF PHYCOMYCES. Cerda-Olmedo, E.; Reau, Patricia (California Inst. of Tech., Pasadena). Mutat. Res.; 9: 369-84(Apr 1970).

The lethal effects of x and uv radiations, N-methyl-N'-nitro-N-nitrosoguanidine, and heat were investigated in multinucleate spores from heterokaryotic mycelia of Phycomyces blakesleeanus. According to their relation to the nuclei, 4 types of lethal events were considered: mitotic (the affected nucleus cannot undergo unlimited mitoses); recessive (the affected nucleus can divide forever, but the cell dies if the affected nucleus is the only one able to divide forever); dominant (when a nucleus is affected, the cell dies irrespective of the condition of other nuclei); and cytoplasmic (the nuclei are not affected, but the cell dies); X rays cause principally mitotic lethals, and, somewhat less frequently, recessive lethals. Ultraviolet light produces mitotic and recessive lethals at similar rates; photoreactivation reverses them about equally and simulates a dose reduction. The lethal action of nitrosoguanidine depends on the pH and the chemical composition of the buffer; as extreme cases, in pH 7 citrate-phosphate buffer it consists mainly of equal proportions of mitotic and recessive events, but in pH 5 Tris–malate buffer cytoplasmic and recessive events seem predominant. Heat (55°) causes only cytoplasmic lethality. Functionally uninucleate cells, important in the isolation of recessive mutants, are obtained best with x-rays. After treatments with uv radiation or nitrosoguanidine in pH 7 citrate-phosphate buffer leads to the survival of one-tenth of the spores, about one-third of the survivors are functionally uninucleate. (P.B.M.)

50861 ABNORMAL FREQUENCIES OF SPONTANEOUS MITOTIC RECOMBINATION IN uvsB AND uvsC MUTANTS OF ASPERGILLUS NIDULANS. Jansen, G. J. O. (State Univ., Utrecht). Mutat. Res.; 10: 33-41(Jul 1970).

The recombination behavior of two uv sensitive mutants of Aspergillus nidulans (uvsB10 and uvsC14) is described. The frequency of spontaneous mitotic intragenic recombination is abnormally high in a uvsB10/uvsB10 diploid and abnormally low in a uvsC14/uvsC14 diploid. In sexual crosses between uvsB10 haploids the frequencies of meiotic inter and intragenic recombination are normal. Sexual crosses between uvsC14 haploids are sterile. Both uvsB10 and uvsC14 are recessive to their wild type alleles. The possible ways in which uvsB10 and uvsC14 affect recombination are discussed. (auth)

50862 SOLUBILIZATION OF DNA IN BACILLUS SUBTILIS DURING RECOVERY FROM UV-IRRADIATION. Reiter, Harvard (Kansas State Univ., Manhattan). Mutat. Res.; 10: 7-10(Jul 1970).

Autoradiography of individual Bacillus subtilis cells in a uv-irradiated population shows that extensive degradation of DNA occurs only in those cells that do not recover the ability to divide and form microcolonies. (auth)

Health Physics and Safety

Refer also to abstract 50450.

Radioactive Contamination and Decontamination

Refer also to abstracts 50795, 50801, and 50805.

50863 (CEA-CONF-1549) TREATMENT OF CONTAMINATIONS BY ^{239}Pu. Lafuma, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1970. 14p. (In French). (CONF-700505-7). Dep. CFSTI (U. S. Sales Only).

From 2nd Congress of the International Radiation Protection Association, Brighton, England.

Accidents may be divided into two groups, those caused by contamination and accidents of inhalation. Experiments were carried out on ^{239}Pu at the valence 3 and 4 and on other actinides. Actinides and lanthanides may be found in the biological medium as colloids or ions bound with artificial or natural carriers. Therapeutic facilities are discussed in relation to the metabolism of the element. Therapeutics should necessarily include internal decontamination and entrance path decontamination (skin injury, inhalation or ingestion). The chelating agent used in internal decontamination is DTPA that does not present any functional toxicity. Two cases are considered according to whether the element is in solid state (oxide-metal) or in solution. The treatment of the injured man contaminated at Fontenay aux Roses in June 1962, is given as an example. (auth) (France)

50864 (LF-tr-43) RADIOACTIVE POLLUTION OF THE AIR AND PULMONARY CONTAMINATION. Maisin, J. R. Translated by A. A. Horvath (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.), from Acta Tuberc. Pneumol. Belg.; 58: 608-17(Sept-Oct 1967). 11p. Dep. CFSTI.

In all of the industries handling radioactive substances there is a constant danger of radiocontamination of the personnel. These contaminations are frequently chronic and seldom acute. The amount of inhaled radioactive substance, which reaches the alveolary surface of the lungs, is estimated as 25%. The severity of a contamination depends notably on the amount of the radioelement taken in, and on the nature of its biological and physical half-life. In contamination by a given radioelement, its physical and chemical form is important. The pulmonary dosimetry is difficult (nonhomogeneous dispersion of the focal sources emitting radiations of mostly weak energy). The danger of pulmonary contamination is due partly to the absorption of the radioelement into the circulation and its deposition in a critical organ, as well as to the irradiation of the lungs as such. It is thus, that the individuals that are subject to an essential contamination of the lungs, can suffer from shortness of breath, of tenacious cough, of pneumoconiosis, emphysema, heart disease, and an increased incidence of pulmonary cancer. The treatment of pulmonary contamination consists in promoting the elimination of radioactive substances by physiological means (stimulation of natural means of elimination), as well as by chemical means (by chelating agents, which combine with the radioelements and modify their physical and chemical state, and facilitate their removal). In spite of the dan-

gers that are inherent in the pulmonary contaminations, as the result of inhalation of radionuclides, one should not underestimate the gravity of external irradiation of the lungs by a large dose of radiations. (auth)

50865 DETERMINATION OF THE ^{131}I PRODUCED BY NUCLEAR EXPLOSION TESTS CARRIED OUT BY FRANCE IN THE SOUTH PACIFIC. Penna Franca, E.; Dos Santos, P. L.; Paschoa, A. S. (Univ. Federal, Rio de Janeiro. Pontificia Univ. Catolica, Rio de Janeiro). An. Acad. Brasil. Cienc.; 41: 583-9(Mar 1969). (In Portuguese).

In 1954 van Middlesworth reported that thyroid glands of cattle going to slaughter contained appreciable amounts of radioactive iodine presumably from the environmental contamination of weapons tests. Since the original report he and others have followed the levels of ^{131}I in thyroid and milk of domestic animals and also in human thyroids in the United States, Europe, and Asia after each series of nuclear weapons tests. (auth)

50866 RADIOPROTECTION IN INSTALLATIONS WHERE PLUTONIUM IS HANDLED. MEASURE OF THE CONTAMINATION OF PERSONNEL. Colard, J. (CEN, Mol, Belg.). J. Belge Radiol.; 53: 56-65(Jan-Feb 1970). (In French).

The difficulties encountered in direct measurement of the radiation originating from plutonium fixed inside the human body are explained. Methods that can be applied for measuring the contamination of wounds and of the lungs are described. (auth)

50867 TREATMENT OF RADIOACTIVE BIOLOGICAL WASTES. Fekher, L.; Gach, F. (City Hygiene Dept., Budapest). At. Energ. (USSR); 28: 346-8(Apr 1970). (In Russian).

The preferred method of treating biological waste is by burning. However, since the volume of waste requiring centralized storage and treatment in Hungary is small (4 to 5 m^3 per year), encasement in concrete, gypsum or asphalt can be used as a temporary measure. The biological waste was found to have the following radioactive, isotopic composition: 6.1% ^{3}H, 31.5% ^{14}C, 1.9% ^{22}Na, 15.5% ^{35}S, 8.2% ^{51}Cr, 4.8% ^{59}Fe, 8.4% ^{65}Zn, 3.5% ^{90}Sr, 14.7% ^{204}Tl and 3.4% of other isotopes. The specific activity varied from 0.01 to 5 $\mu c/g$ of tissue. The animal composition was: 4.7% mice, 70.6% rats and guinea pigs, 10.8% rabbits and cats, 11.9% pigs and dogs, and 2% horses and cattle. The tissue was preserved in formaldehyde and then mixed with concrete or gypsum. After hardening the concrete or gypsum was encased in asphalt and stored in the open. Samples taken 3 years later were found to be sterile. This method keeps radioactivity out of the environment. There are some reservations about using gypsum which is easily crushed. Studies are being carried out on the possible use of synthetic polymeric bags to encase the biological wastes. (TTT)

50868 EFFECTS OF SODIUM ALGINATE ON THE ABSORPTION AND RETENTION OF SEVERAL DIVALENT CATIONS. Silva, A. J.; Fleshman, D. G.; Shore, B. (Univ. of California, Livermore). Health Phys.; 19: 245-51(Aug 1970).

Whole-body counting techniques with a specially designed system were used to test sodium alginate as a countermeasure for the removal of several divalent radionuclides from rats. A 20% alginate diet started three days before administration of a radionuclide mixture and continued for three weeks was effective in decreasing the retention of the radionuclides in the following order: Ba > Sr > Sn > Cd > Mn > Zn > Hg > Co. The ^{133}Ba levels were reduced to 3% of control values and ^{109}Cd and ^{54}Mn levels to about 50%; ^{60}Co levels were not affected. (auth) (UK)

50869 β-RADIOACTIVITY OF THE TREE PIN IN SUDETY. Grossman, Andrzej (Politechnika Slaska, Gliwice, Poland); Kwapulinski, Jerzy. Acta Geophys. Pol.; 18: 235-42(1970). (In Polish).

The β-radioactivity of samples of soil, moss, and needles of pine, spruce, fir, and dwarf-mount-pine was measured by means of anticoincidence methods with a background of 2 imp/min. The counter, type BAH-55, was placed in p-terphenyl scintillator in toluene POPOP. The measurements indicated that the specific radioactivity of samples increased with altitude. Maximal radioactivity of fir needles (1056.3 pCi/g) and of dwarf-mount-pine needles (1343.2 pCi/g) was found at mount W. Szyszak. The correlation coefficient between the specific β-radioactivity and altitude is 0.58 for fir needles and 0.52 for dwarf-mount-pine needles; between specific β-radioactivity and precipitation, 0.52 and 0.88 respectively. The specific radioactivity of the undermoss-soil was higher than that of the surface soil. (auth)

50870 ACCIDENTS RADIOLOGIQUES: CONDUITE A TENIR EN CAS D'IRRADIATION EXTERNE ACCIDENTELLE OU DE CONTAMINATION RADIOACTIVE ACCIDENTELLE. (Radiological Accidents: Action to be Taken in Case of External Irradiation or Accidental Radioactive Contamination). Jammet, H.; Le Go, R.; Lafuma, J. Paris; Commissariat a l'Energie Atomique (1969). 59p.

The action to be taken in the case of external overexposure by photon or particle irradiation is summarized including the definition of accidental overexposure, recovery of data from dosimetry, clinical and biological action, and therapy. In accidental radioactive contamination the problems posed by the emergency treatment of internal contamination are related to metabolic data associated with physico-chemical bases. The relations between metabolism and the physico-chemical state are first considered. The basic therapeutic procedures are indicated and radioelements posing particular problems are considered. These include ^{14}C, isotopes of Cs, I, and Pu, mixed fission products, Sr isotopes, rare earths, transplutonium elements, tritium, and uranium. (J.S.R.)

50871 ^{90}Sr AND ^{137}Cs CONCENTRATIONS IN IMPORTED FOODS. 4. Urakubo, Goro; Kametani, Katsuaki; Ikebuchi, Hideharu (National Inst. of Hygienic Sciences, Tokyo). Eisei Shikenjo Hokoku; No. 87, 84-6(Dec 1969). (In Japanese).

^{90}Sr and ^{137}Cs concentrations in imported dried milk produced during the period from June 1967 to Jan. 1968 were tested. Average values of concentrations of ^{90}Sr and ^{137}Cs in imported dried milk (12 samples) were 13.9 pCi/100 g and 38.4 pCi/100 g, and these values in dried milk produced in Hokkaido in the same period were 21.3 pCi/100 g and 268.7 pCi/100 g. (auth) (Japan)

Dosimetry and Monitoring

Refer also to abstracts 50546, 50551, 50553, 50676–50678, 50681, 50686, 50785, 50798, 50807, 50983, 51002, 51009, 51030, 51031, and 51063.

50872 (BNWL-1341) EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD FOR 1968. Wilson, C. B. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1970. Contract AT(45-1)-1830. 77p. Dep. CFSTI.

At the Hanford project, controlled releases of a variety of low-level radioactive wastes are made to the Columbia River, to the ground, and to the atmosphere. The major source of low-level wastes released to the environment in 1968 continued to be reactor cooling water discharged to the Columbia River. Evaluation of the combined offsite effects of all radioactive waste releases during 1968 showed that concentrations of radionuclides in the environs and radiation doses received by nearby population groups were well within accepted standards. Doses were estimated for the whole body, gastrointestinal-tract, and thyroid as in previous years and, for the first time, the annual intake of bone-seeking radionuclides was also expressed in terms of dose to skeletal bone. The population considered included the Maximum Individual, the Average Richland Resident, and the Typical Richland Resident. Population dose estimates were less than one-tenth of the appropriate standards except for the skeletal bone of the Maximum Individual (17% of the 1500 mrem/year standard) and for the thyroid of the infant Typical Richland Resident (11% of the 500 mrem/year standard). A single radionuclide, ^{32}P, contributed 96% of the estimated skeletal bone dose received by the Maximum Individual with Columbia River fish the major source of intake. On a comparable basis, these population dose estimates for 1968 would represent a decrease from those of 1967. However, because of changes in the method of computation, the percentages of standard for 1968 are not directly comparable to those reported for 1967. (auth)

50873 (CONF-691212) MEDICAL RADIONUCLIDES: RADIATION DOSE AND EFFECTS. Proceedings of a Symposium held at the Oak Ridge Associated Universities, December 8–11, 1969. AEC Symposium Series 20. Cloutier, Roger J.; Edwards, C. Lowell; Snyder, Walter S. (eds.) (Bureau of Radiological Health, Rockville, Md. Division of Biology and Medicine (AEC), Washington, D. C.). Jun 1970. 528p. Dep. CFSTI.

Separate abstracts were prepared for each of the 32 papers presented. The subjects fall generally into three groups: (1) mathematics for calculating radiation dose from radionuclides administered to a patient; (2) distribution and retention of radionuclides in patients; and (3) biological effects of radionuclides. A list of participants and a subject index are provided. (C.O.)

For abstracts of individual papers see: 50546, 50676, 50807, 50874–50894, 50939, 50963–50965, 51031, and 51076–51078.

50874 (CONF-691212–, pp 7-15) DEVELOPMENT OF RADIATION DOSIMETRY IN NUCLEAR MEDICINE. Quimby, Edith H. (Columbia Univ., New York. Coll. of Physicians and Surgeons).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

Dosimetry in nuclear medicine started with early efforts to specify radium dosage. It was soon appreciated that there were great differences among the emitted dose (the energy leaving the source), the delivered dose (the energy arriving at the target), and the absorbed dose (the energy actually absorbed by the target). The first was evidently proportional to the amount of radium and the time of exposure, but it was many years before the other two could be satisfactorily defined. This paper presents a descriptive review of the 60-year history of the development of radionuclide dosimetry. (auth)

50875 (CONF-691212–, pp 17-31) GENERAL CONSIDERATIONS IN CALCULATION OF THE ABSORBED DOSE OF RADIOPHARMACEUTICALS USED IN NUCLEAR MEDICINE. Smith, Edward M. (Miami Univ., Coral Gables, Fla. School of Medicine).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

The current status of absorbed-dose calculations for internally administered radiopharmaceuticals is summarized, the problems associated with the computation of dose are discussed, and how dose information could aid the clinician in obtaining more definitive diagnostic information is illustrated. The basic equations used for calculating the dose are reviewed along with the problems associated with obtaining the necessary nuclear, radiation-interaction, and biologic data. The method of computing dose is illustrated. In addition, a protocol is given that maximizes the clinical information obtained from a nuclear medical study while minimizing the absorbed dose to the patient. (auth)

50876 (CONF-691212–, pp 33-49) ESTIMATION OF ABSORBED FRACTION OF ENERGY FROM PHOTON SOURCES IN BODY ORGANS. Snyder, Walter S. (Oak Ridge National Lab., Tenn.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

A Monte Carlo-type calculation is described that estimates the absorbed fraction of energy in organs of the human body from a monoenergetic source of photons uniformly distributed in a body organ. The calculation takes account of the size, shape, location, and composition of the body and of body organs in an approximate sense. Typical results of the calculation, as published in Medical Internal Radiation Dose (MIRD) Pamphlet 5, are presented. The validity of the reciprocity dose theorem and the effect of organ mass on the absorbed fraction are discussed in light of these calculations. (auth)

50877 (CONF-691212–, pp 51-62) DECAY-SCHEME ANALYSIS FOR USE IN ESTIMATING INTERNAL DOSE. Dillman, L. T. (Ohio Wesleyan Univ., Delaware).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

Procedures employing a computer program that can be used to determine the energies and intensities of all the radiations that may be emitted in a radioactive decay are discussed. In particular, determination of the average energy of betas in a beta spectrum is discussed. Also, determination of the energies and intensities of the various x-ray and Auger-electron groups that arise as a result of electron-capture decay and as a result of the internal conversion of gamma rays is discussed in detail. The electron-capture decay of ^{197}Hg is used as an example. (auth)

50878 (CONF-691212–, pp 63-86) BETA-RAY DOSIMETRY CALCULATIONS WITH THE USE OF POINT KERNELS. Berger, M. J. (National Bureau of Standards, Washington, D. C.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

Some work on the evaluation, compilation, and use of point kernels in beta-ray dosimetry is described. Such kernels describe the distribution of absorbed dose around point sources. By the superposition of such kernels, one can determine the spatial pattern of absorbed dose in media in which a beta-emitting radionuclide is distributed in some specified fashion. The superposition method has the advantage of great economy. It is not completely realistic, however; its applicability is limited to media that are in effect unbounded and which are homogeneous in composition and uniform in density. Under the auspices of the Medical Internal Radiation Dose (MIRD) Committee of the Society of Nuclear Medicine, point kernels have been compiled for 75 radionuclides. These results are theoretical and are based on information about the shapes of beta spectra (obtained from the Oak Ridge National Laboratory Nuclear Data Group), data about electron stopping power and range values, and point kernels for monoenergetic sources calculated by Spencer. Confirming earlier findings by Cross, it is shown that the theoretical point kernels are in good agreement with corresponding experimental data for air and polystyrene. In a digression, a brief indication is given—derived from the analysis of Monte Carlo calculations—of how much the absorbed dose is reduced near a boundary through which the beta particles can escape from but not return to the medium, e.g., near an air–tissue interface. Finally, some considerations are presented concerning techniques useful for carrying out the numerical integrations for the superposition of point kernels. The examples discussed include the absorbed-dose distributions near line and plane sources, the absorbed-dose distributions inside and outside of volume sources with spherical and cylindrical shapes, and the self-absorption of beta-ray energy in slabs and spheres. (auth)

50879 (CONF-691212–, pp 87-102) STANDARD MAN: STANDARD PATIENT. Morgan, Karl Z. (Oak Ridge National Lab., Tenn.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

Characteristics of the standard man were first agreed upon at the Chalk River conference in September 1949. Today he is referred to as the reference man. Calculations making use of this man can be compared rather easily and the final conclusions evaluated with any other similarly referenced calculations. The International Commission on Radiological Protection (ICRP) reference-man report and the companion report, the revised ICRP internal-dose handbook, are expected to be published in 1970 and 1971, respectively. In the revised ICRP internal-dose handbook, considerable use will be made of the ICRP reference-man report, lung-model report of P. E. Morrow et al., and the ICRP GI tract report of I. S. Eve, as well as MIRD Supplements 2 and 3 by L. T. Dillman and W. S. Snyder. Much of the data in these reports regarding the characteristics of the reference man and dose calculations for some 300 radionuclides will provide guidance in estimating the dose from these same radionuclides when they are administered to the patient. The revised ICRP internal-dose handbook will be more applicable for calculating patient dose than the previous report because information is provided for specific chemical compounds rather than for just soluble and insoluble compounds. When making medical application of these data, the limitations and assumed characteristics of the reference man must be recognized, and appropriate account must be taken of age, sex, weight, metabolic pattern, condition of health, chemical blocking, etc., of the patient. The choice of radionuclide, its chemical form, and its method of administration to the patient are important not only in determining whether a medical procedure or treatment is successful but also from a health physics point of view in avoiding unnecessary patient exposure. The reference-man reports should provide guidance in estimating dose from conventional medical applications of radionuclides to the patient and should indicate ways to avoid unnecessary patient exposure and also suggest new and better applications of radionuclides for treatment and diagnosis. (auth)

50880 (CONF-691212–, pp 103-13) POSTMORTEM STUDIES OF RADIONUCLIDES IN MAN. Nelson, Bill (Oak Ridge Associated Universities, Inc., Tenn.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

For calculating radiation doses from radiopharmaceuticals, we need to know the concentrations in various tissues. By studying living patients, we may estimate certain tissue concentrations at successive intervals after administration; but complete assays are possible only after death. When the dose and the properties of the radionuclide are suitable, scans and gross autoradiograms may assist in the selection of samples for assay. Histologic examination is needed to characterize some of the assay samples, especially those from diseased tissues of diverse composition. For direct measurements of activity in entire organs, whole-body counters and large-sample counters are useful, but such measurements may be inadequate for calculating radiation doses because even tissues that seem homogeneous by assay of many small samples can have significant focal concentrations. Autoradiography is invaluable for confirming homogeneity and for demonstrating variations in concentration requiring more detailed assay. Conclusions about the distribution at autopsy must be qualified. They involve the physicochemical state of the radionuclide, the carrier, the route of administration, the time between the dose and death, the circulatory status of the patient, and other effects of illness. Careful planning and analysis enhance the value of the autopsy, providing information that is a unique gift of the dead to the living and to posterity. (auth)

50881 (CONF-691212–, pp 133-56) TOTAL- AND PARTIAL-BODY COUNTING OF CHILDREN FOR RADIOPHARMACEUTICAL DOSIMETRY DATA. Wellman, H. N.; Branson, B. M. (Bureau of Radiological Health, Cincinnati, Ohio. Nuclear Medicine Lab.); Kereiakes, J. G. (Cincinnati General Hospital, Ohio).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

A continuing program is being conducted by the Bureau of Radiological Health, Nuclear Medicine Laboratory, and the Radioisotope Laboratory of the University of Cincinnati Medical Center to obtain biologic data on radiopharmaceutical behavior, particularly in children. Profile-scanning whole-body-counter techniques and partial-body counting have been used to obtain long-term data in 32 children treated with a variety of radiopharmaceuticals. Whole- and partial-body doses have been calculated with data obtained in these children. Iodine-131 thyroid doses range from 1.2 to 30 rads per microcurie of administered dose. Because of very high thyroid uptakes in neonates, the consequent absorbed doses probably contraindicate such studies for the diagnosis of hyperthyroidism. Pure ^{123}I would reduce the thyroid dose 100-fold. Organ weights, particularly thyroid weights, are reviewed for dosimetry purposes. Also, absorbed-fraction values for the small organs found in children are presented. Tissue doses based on the measured biologic data are reviewed, with ^{59}Fe, ^{197}Hg–chlormerodrin, ^{75}Se–selenomethionine, and ^{85}Sr usually exceeding 30 mrads per microcurie of administered dose to either the whole body or the critical organ. (auth)

50882 (CONF-691212–, pp 157-84) DOSIMETRY OF SELECTED PROCEDURES USING X RAYS AND RADIOACTIVE SUBSTANCES. Trott, N. G.; Stacey, A. J.; Dermentzoglou, Flora M. (Institute of Cancer Research, Sutton (England). Surrey Branch); Ellis, R. E. (Saint Bartholomew's Hospital Medical Coll., London (England).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

In considering the hazards associated with diagnostic examinations involving ionizing radiation, particular attention has usually been given to the somatic risks arising from irradiation of the bone marrow and the developing ovum and fetus and to the genetic risks of irradiating the gonads. Consequently, in various surveys of x-ray diagnostic techniques involving large populations, the measurements have been planned so that the data obtained can be used conveniently in calculating doses to these sites. In estimating doses from radioisotope procedures, however, attention has not been especially directed to this group of sites, but a more comprehensive assessment of the dose to various organs has usually been attempted. In this paper the tables give the doses received by various organs in a number of well-established types of x-ray and radioisotope tests, those selected being examinations of the brain, skeleton, lungs, liver, kidneys, and placenta. Much of the data in these tables are from previously published work; these data have been supplemented by estimates of doses to particular organs under examination by x-ray methods, and for radioisotope tests the dose to the bone marrow had usually to be inferred from the available estimates of the dose to the skeleton or the whole body. In general, doses to gonads and bone marrow for the radioisotope procedures are lower than those for complementary x-ray tests, whilst dose rates in the x-ray examinations are generally 100 to 1000 times greater than in the radioisotope tests. However, the efficiency of radioisotope tests, in terms of radiation received during the examination as a fraction of the total, is 10% or less. The integral dose for some well-established x-ray procedures is of the order of 5 to 90 kg-rads, values that may be compared with about 15 kg-rads for a widely used radioisotope examination of the liver with ^{99m}Tc colloid. Several summaries of the histories of particular patients are given; they illustrate the considerable number of tests to which a particular individual may be exposed. It may be concluded that, where increase of the activity used would evidently improve the quality of the result of a radioisotope test, restrictions on the activity administered should be examined in the light of the complete schedule of tests likely to be used. Finally, it is noted that diagnostic procedures with radioisotopes in the United Kingdom probably still contribute less than 1% to the total genetic dose due to medical use of ionizing radiation. (auth)

50883 (CONF-691212–, pp 185-206) DETERMINATION OF RADIATION DOSE AND ASSESSMENT OF CLINICAL RESULTS AFTER RADIOIODINE TREATMENT. Pfannenstiel, P. (Freiburg Univ. (West Germany). Medizinische Klinik).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

Methods by which doses in ^{131}I therapy can be estimated not only to the target tissue but also to the body as a whole are described. Simplified dose formulas are employed. The calculated therapeutic doses tend to be significantly lower than those in most comparable series. Since the results are satisfactory, the use of smaller doses is an advantage. The potentially important biological aspects of whether radiation doses in nuclear medicine differ in their biological effects, owing to tissue recovery at a lower protracted dose rate, from those of external irradiation, which is usually administered in daily fractions, are emphasized. (auth)

50884 (CONF-691212–, pp 207-23) BETA DOSE TO SPINAL CORD AND NERVE ROOTS IN ^{131}I–HSA CISTERNOGRAPHY. Zeiger, Louis S.; Davidson, Jack D. (National Institutes of Health, Bethesda, Md.); Harbert, John C.; McCullough, David (Georgetown Univ., Washington, D. C. Hospital); Ashburn, William L. (University Hospital of San Diego County, San Diego, Calif.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

After the lumbar intrathecal administration of ^{131}I–human serum albumin to patients, the activity remaining in various segments of cerebrospinal fluid (CSF) was monitored by external counting. From the activity remaining in each segment as a function of time, the cumulated activity for each segment was calculated. Three categories of patients were studied: (1) normal CSF flow pattern, (2) hydrocephalic flow pattern, and (3) cisternal or spinal subarachnoid block. The beta absorbed dose as a function of the distance from the spinal-cord or nerve-root surface was calculated. If one assumes the range of CSF segmental volumes to be 10 to 35 cm^3 and a normal CSF flow pattern, the beta dose to the surface of the spinal cord ranges from 3.0 to 7.0 rads and to the nerve root ranges from 3.7 to 9.0 rads. The beta dose distribution was calculated for the mean cumulated concentration of each of the preceding patient categories and for the appropriate volume range. The extreme dose was found to occur in a patient with a cervical subarachnoid block where the beta dose to the spinal-cord surface ranged from 25.0 to 60.0 rads and the beta dose to the nerve-root surface ranged from 30.0 to 75.0 rads. In the patient with a cervical subarachnoid block, the tracer of choice is ^{99m}Tc–albumin since the same diagnostic information can be obtained at a significant reduction of absorbed beta dose when compared to ^{131}I–albumin. (auth)

50885 (CONF-691212–, pp 225-38) DOSIMETRY CONSIDERATIONS FOR RADIOISOTOPICALLY LABELED ORGANIC COMPOUNDS. Winchell, H. Saul (California Univ., Berkeley. Donner Lab.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

The kinetic-analysis approach to estimates of tissue-concentration changes of radioisotopes contained in organic molecules is reviewed. Subsequent to administration of labeled materials, repeated measurements of tracer content in blood, urine, and expired gases are made, and the data are used to estimate the parameters defining suitable mathematical models. Using these models and relative anatomic, histologic, and biochemical data, one can generate functions describing tracer-concentration changes in tissue as a function of time. Two technical recommendations in assessing the adequacy of such a tracer kinetic approach are the total quantity of tracer in the body plus that excreted from the body must at all times be equal to the amount of tracer administered, and the integral of the concentration changes of tracer over the time interval of actual measurement must be very close in value to the integral of the concentration from zero to infinite time. The problems related to a large radiation dose from small residual quantities of radioisotopes are discussed, and examples are given for labeled CO_2–HCO_3^- deposition in bone and labeled amino acid incorporation in long-lived proteins. (auth)

50886 (CONF-691212–, pp 253-70) HANDLING, USES, AND RADIATION DOSIMETRY OF ^{133}Xe. Loken, Merle K.; Kush, George S. (Minnesota Univ., Minneapolis. Hospitals).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

When a radioisotope is used in the study of patients, a primary consideration is the radiation exposure both to patients receiving the radioactive material and to personnel handling and administering the material. During the past 5 years, personnel at the University of Minnesota who routinely transfer 1 Curie of ^{133}Xe gas into saline solution and administer the xenon to patients received low exposures (less than 0.1 of the maximum permissible dose). The radiation dose to body tissues during rebreathing of ^{133}Xe from a spirometer depends on several factors, including the concentrations of ^{133}Xe, rebreathing time, and the clearance rate of the xenon gas by exhalation. When a patient breathes air for 1 min from a 3-liter spirometer containing 30 mCi of ^{133}Xe, the dose to the lung is 127 mrads. During lung perfusion–ventilation studies with ^{133}Xe, the total dose to the lung of the normal subject is 255 mrads from 30 mCi of ^{133}Xe. Patients with delayed washout associated with obstructive lung disease receive a much greater dose to the lung, particularly to those portions that are most severely involved. (auth)

50887 (CONF-691212–, pp 271-94) PROBLEMS IN EVALUATING THE RADIATION DOSE FOR RADIONUCLIDES EXCRETED BY THE KIDNEYS. McAfee, John G. (State Univ. of New York, Syracuse. Upstate Medical Center).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

Accurate estimates of radiation dose to the urinary system for internally administered radionuclides are important since many radioactive agents are concentrated in this system to a high degree in the process of excretion. Anatomical models of the different parts of the urinary tract are proposed to permit computation of the absorbed fraction of gamma photons of different energies for radiation-dose calculations. The methodology for calculation of radiation dose has improved within recent years. Nonetheless, major factors of uncertainty remain in the estimates of radiation levels because of wide biological variations in concentration and retention of radiopharmaceuticals in different subjects. As an example, the biologic data and radiation-dose estimates for chlormerodrin, labeled with ^{197}Hg or ^{203}Hg, are reviewed. (auth)

50888 (CONF-691212–, pp 295-314) DOSE TO VARIOUS SEGMENTS OF THE GASTROINTESTINAL TRACT. Bernard, S. Robert (Oak Ridge National Lab., Tenn.); Hayes, Raymond L. (Oak Ridge Associated Universities Inc., Tenn.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

Four models for estimating the radiation dose from a radionuclide passing through the gastrointestinal (G.I.) tract are reviewed, and a catenary compartment model is derived. From the catenary model, the estimated excretion of a nonabsorbed radionuclide is compared with the excretion of insoluble ^{140}La by humans. With this model, estimates of dose to the various segments of the G.I. tract from oral and intravenous administration of ^{67}Ga are made. (auth)

50889 (CONF-691212–, pp 315-23) DOSE TO THE CELL NUCLEUS FROM TRITIATED THYMIDINE. Johnson, Horton A. (Brookhaven National Lab., Upton, N. Y.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

Tritiated thymidine appears to be amenable to the same dosimetric considerations as those applying to other internal emitters. The dose rate to the cell nucleus, calculated as the rate of energy absorption per unit mass, is compatible with observed biological effects. There seems to be no special hazard due to radiation arising in the genetic material or due to elemental transmutation in DNA. The cumulative doses to cell nuclei are more difficult to estimate, being subject to the uncertainties and variability of the generative cycle. For a given tissue concentration of ^{3}H, specific incorporation into DNA increases the dose rate to nuclei of labeled cells, but selective uptake by cells in the S phase tends to decrease the overall radiation effect on the tissue as a whole. The minimum dose of tritiated thymidine at which a variety of radiation effects becomes manifest in rodents is of the order of 1 μCi per gram of body weight. This corresponds roughly to an initial activity per nucleus of 28 dis/day, or about 8 rads/day for a nucleus 8 μ in diameter. (auth)

50890 (CONF-691212–, pp 325-46) RADIATION DOSE FROM RADIOISOTOPES IN THE BLOOD. Cloutier, Roger J.; Watson, Evelyn E. (Oak Ridge Associated Universities Inc., Tenn.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

The calculated radiation dose rate to the body from radioisotopes distributed in the blood depends on the assumptions used in the calculations. Of these assumptions, the effect of the absorbed fraction for nonpenetrating radiation on the dose rate has not previously been examined in detail. For radioisotopes in the blood, this factor depends on the geometry of the circulatory system. In the larger blood vessels, the absorbed fraction for nonpenetrating radiation approaches one, and little of the energy emitted reaches the organ through which the blood flows. The amount of energy reaching the organ depends on the distribution of blood and the size of the blood vessels. It was concluded that, for many radioisotopes in the blood, the spleen has the highest dose rate of any organ in the body. The effect of isotope retention in the body and the physical half-life on the mean dose from two hematologic tests: ^{59}Fe incorporation into blood cells and ^{51}Cr labeling of red blood cells was examined. In patients with polycythemia vera or endogenous hemochromatosis, the bone-marrow dose from ^{59}Fe incorporation is two to three times the whole-body dose. The spleen dose in these same patients is 15 times the dose to the normal person. From ^{51}Cr-labeled red blood cells, the mean dose to the spleen is more than 100 times that to the whole body and depends on the disease of the patient. (auth)

50891 (CONF-691212–, pp 347-67) DETERMINATION OF ABSORBED DOSE TO BONE AND RED BONE MARROW. Spiers, F. W. (Leeds Univ. (England)).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

Bone structure is briefly reviewed in relation to the ranges of ionizing particles and the location of the tissues at risk. Methods of calculating the absorbed dose to tissues in cortical bone are given together with data on the dose from beta-emitting radionuclides incorporated in bone. Particular attention is given to new methods of calculating the average dose to bone marrow from beta emitters, and results are given for a range of radionuclides from ^{14}C to ^{90}Sr + ^{90}Y. Some consideration is also given to the ratio of absorbed dose/exposure for photon irradiation in the energy range 25 to 200 keV. (auth)

50892 (CONF-691212–, pp 399-411) DOSE-EFFECT MODIFYING FACTORS IN INTERPRETING MEDICAL EXPOSURES. Bond, V. P. (Brookhaven National Lab., Upton, N. Y.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

Dose–effect modifying factors, which must be considered in addition to absorbed dose in estimating the degree of possible effect of exposure to ionizing radiation, are discussed with specific reference to diagnostic nuclear medicine. The framework and terminology used by the International Commission on Radiation Units and Measurements, the National Council on Radiation Protection and Measurements (NCRP), and similar groups to characterize dose–effect modifying factors appear to be suitable at present for use in nuclear medicine. The NCRP has recommended numerical values for the quality factor that appear to be appropriate for present use in nuclear medicine. The possible requirement for introducing additional dose–effect modifying factors to take into account dose rate, dose distribution, and chemical effects produced in the course of the disintegration of certain isotopes is discussed. It is concluded that, although some of these possible factors require additional study and their use may become necessary at a later date, there is no compelling reason at present for their introduction. (auth)

50893 (CONF-691212–, pp 473-9) ACTIVITIES OF THE MEDICAL INTERNAL RADIATION DOSE COMMITTEE (MIRD) OF THE SOCIETY OF NUCLEAR MEDICINE. Rohrer, Robert H. (Emory Univ., Atlanta, Ga.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

The Medical Internal Radiation Dose (MIRD) Committee of the Society of Nuclear Medicine was formed in 1964 to serve the increasing needs of the nuclear medical community with the best estimates of the absorbed dose to patients who are administered radiopharmaceuticals. To achieve this goal, the committee proposed to develop, collect, and critically evaluate information in the following areas: Formulas, units, and symbols that are consistent for absorbed-dose calculations by either manual or computer techniques; physical and nuclear decay-scheme data needed as input for the formulas developed; metabolic data on the distribution and lifetimes of radionuclides administered as labeled pharmaceuticals for the total body, specific organs, and suborgan regions, as well as to consider the influence of the patient's age and clinical state on these variables; chemical, radiochemical, and radionuclidic purity and stability and physical characteristics of radiopharmaceuticals when they are apt to affect the absorbed dose to the patient; accuracy of the calibration methods used for determining the activity of a radiopharmaceutical; and anatomic and physiologic data for patients of various ages and body types. The committee has adopted the absorbed-fraction concept for computing absorbed dose. The first three publications of the committee contain the recommended methods for calculating the absorbed dose, physical radionuclide data, and extensive tables of absorbed fractions. Many of the publications currently in preparation are directed to the estimation of absorbed dose resulting from specific radiopharmaceuticals. The work of the MIRD Committee is open-ended and will continue as long as new radiopharmaceuticals are developed. (auth)

50894 (CONF-691212–, pp 481-9) SOME REMARKS ON THE MIRD SCHEMA FOR ABSORBED-DOSE CALCULATIONS FOR BIOLOGICALLY-DISTRIBUTED RADIONUCLIDES. Loevinger, Robert (National Bureau of Standards, Washington, D. C.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

The origin of the Medical Internal Radiation Dose (MIRD) Schema [Journal of Nuclear Medicine, Supplement No. 1 (February 1968)] is described. The basic concepts, equations, and advantages are discussed and explained. The concept of specific absorbed fraction allows formulation of a single equation that covers internal-dose calculations for all radiations, sources, and targets. (auth)

50895 (COO–119-241, pp 2-24) DESIGN AND CALIBRATION OF A TOTAL-BODY COUNTING SYSTEM FOR MEASURING RADIOACTIVITY IN BEAGLES. Lloyd, R. D.; Taysum, D. H.; Mays, C. W. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Retention and dosimetry of some injected radionuclides in beagles.

A positioner for holding dogs during whole-body counting was designed. It was constructed so that when an animal is placed on his back, his midline is curved into a 33-cm radius arc, which approximates an isoresponse line for an 8 inch × 4 inch NaI(Tl) crystal positioned with its face at the center of curvature for this arc. Counter response is relatively independent of the location of an emitter at various points along the dog's midline. The positioner molds the animal to a uniform 15 cm lateral thickness so that body attenuation of photons is similar among adult beagles. Effects on counting rate of differences in position of dogs within its confines are small. Calibration was accomplished by counting in this positioner eight dogs containing various radionuclides. Their body burdens were then determined by the radioactivity of their individual bones and tissues following autopsy. (auth)

50896 (COO-119-241, pp 144-62) ^{232}Th SKELETAL DOSIMETRY AND TOTAL-BODY ^{212}Bi RETENTION IN BEAGLES. Lloyd, Ray D.; Mays, Charles W.; Atherton, David R.; Taylor, Glenn N.; Rehfeld, Carl E.; Van Dilla, Marvin A.; Stover, Betsy J. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Retention and dosimetry of some injected radionuclides in beagles.

Total-body retention of ^{212}Bi, a radioactive daughter of ^{232}Th, was measured for burden times of up to 7.9 yrs by γ-ray counting in a group of 84 Beagles injected intravenously with 0.00159 to 2.76 μCi ^{232}Th/kg in a citrate buffer at an average age of about 1.4 yrs. In 14 animals sacrificed 1 to 1511 days after injection, about 84% of the retained ^{232}Th was in the skeleton, 4% in the liver, 2% in the kidneys, 3% in the pelt, and 2% in the GI tract, with some dependence of relative distribution upon time after injection. Radiation doses and dose rates from ^{232}Th and its daughters in the skeleton were calculated based on the assumptions that following an initial deposition of about 69% of the injected ^{232}Th in bone, the biological half-time of this radionuclide in the skeleton was about 13.6 yrs, the ^{224}Ra/^{232}Th ratio in the dog was 0.895, the corresponding ^{212}Bi/^{232}Th ratio was 0.866, and that these ratios were independent of time after injection. (auth)

50897 (DPST-70-30-2) EFFECT OF THE SAVANNAH RIVER PLANT ON ENVIRONMENTAL RADIOACTIVITY. Semiannual Report, January-June 1970. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Contract AT(04-2)-1. 18p. Dep. NTIS.

The results of the environmental monitoring program for the atmosphere, vegetation, milk, and water are reported for the period January 1 through June 30, 1970. The quantity of radioactive waste released by the Savannah River Plant to its environs was, for the most part, too small to be distinguished from natural background radiation or was obscured by fallout from offsite sources. Beta activity in air, which showed no relation with plant operations, was 1.7 times that observed during 1969. Radioactive materials in fish flesh continued to be far below levels considered significant from a health standpoint. The average concentration of any radionuclide in river water at Highway 301 did not exceed 0.4% of the concentration guide. (auth)

50898 (IS-2393) SURVEY OF ENVIRONMENTAL RADIOACTIVITY FOR PERIOD JANUARY 1-JUNE 30, 1970. Voss, Milo D. (Ames Lab., Iowa). Aug 1970. Contract W-7405-eng-82. 20p. Dep. CFSTI.

The environmental program consists of air samples, soil, vegetation, river water, bottom sediment, precipitation, pond water, ALRR (Ames Laboratory Research Reactor) outfall, and well water samples. The ALRR reached full power as of 7/12/65. As of 12/31/69 the ALRR had generated 105,409 megawatt hours of heat. A total of 122,258 megawatt hours of heat was generated as of 6/30/70. The data indicate that the ALRR has not contributed a significant amount of radioactivity to the environment in the Ames area. The conclusion is reached that radioactivity levels recorded for environmental samples represent background conditions from atmospheric fallout and naturally occurring radioactivity. (auth)

50899 (NYO-3510-16) BIOLOGICAL AND CLINICAL DOSIMETRY. Comprehensive Six-Year Progress Report, July 1, 1964-June 30, 1970. Laughlin, John S. (Sloan-Kettering Inst. for Cancer Research, New York). 31 July 1970. Contract AT(30-1)-3510. 132p. Dep. CFSTI.

Research activities in biological and clinical dosimetry during July 1, 1964 to June 30, 1970 are reported. The projects reported on are presented under the following general areas of interest: absorbed dose microcalorimetry; clinical dosimetry; biological dosimetry; neutron dosimetry; dosimetry of ultra high intensity radiation sources; and solid state detector evaluation. Titles of 17 publications and presentations by the staff during the reporting period are listed. Eighty-nine references are cited and 81 illustrations are included. (E.R.B.)

50900 (ORNL-tr-2385) QUANTITATIVE DETERMINATION OF THE CONTENT OF THE RADIOISOTOPES OF LEAD AND BISMUTH IN MINE ATMOSPHERE. Baranov, V. I.; Gorbusina, L. V. Translated by Lynda H. Kern (Oak Ridge National Lab., Tenn.), from Kernenergie; 4: 154-5(1961). 4p. Dep. CFSTI.

A method is proposed for quantitatively determining the lead (RaB and RaD) and bismuth (RaC and RaE) isotopes in uranium mine air. The method employs the individual radiochemical determination of the isotopes (RaB and RaD, and RaC and RaE) that is deposited on a BF filter. Following preparation of the samples, measurements are made of the β activities in a type B counting cup and decay rates for the individual isotopes are plotted (cpm vs time). RaD is determined from the increase, in time, in the β activity of RaE while RaE is determined by deducing the half-life from the decay-rate curves. RaB and RaC are determined by similar deductions and the number of atoms of each in the air calculated from the measured curves. (E.R.B.)

50901 (UCRL-50007-70-1) HAZARDS CONTROL. Progress Report No. 36, January-May 1970. (California Univ., Livermore. Lawrence Radiation Lab.). 20p. Dep. CFSTI.

Research and surveillance activities of the Hazards Control Department (HCD) of the Lawrence Radiation Laboratory during January to May, 1970 are reported. Areas of interest include: radiation protection (dosimetry and surveillance activities); industrial hygiene (respiratory cartridge and filter testing); instrumentation development (detectors, monitors, and dosimeters); and education (new course offerings in HCD). Technical notes of interest on research and surveillance activities in the HCD, for which future reporting is doubtful, are also included. Publications by staff members during the reporting period are listed. (E.R.B.)

50902 METHOD FOR ASSESSING NEUTRON DOSE EQUIVALENT RATE IN OPERATIONAL HEALTH PHYSICS. Minami, Kentaro (Japan Atomic Energy Research Inst., Ibaraki); Fukuda, Seiji; Yoshida, Yoshikazu. Hoken Butsuri; 5: 1-11(Mar 1970). (In Japanese).

Many types of survey instruments for measuring exposure dose from neutrons and methods for assessing the dose equivalent rate have been developed in many countries. In the JAERI, extensive efforts were made to establish a method to assess neutron dose equivalent. The main objectives of this report are to introduce the principle of measuring neutron dose equivalent rate based on an orthonormal expansion method and to describe its application for the operational health physics in JAERI. This report also describes an experience with the various types of neutron survey instruments that have been employed for radiation protection in JAERI since 1958. (auth) (NSA of Japan)

50903 NINTH ANNUAL MEETING OF PHYSICS IN MEDICINE AND BIOLOGY. Clarke, K. H.; De Groot, R. J. (Cancer Inst., Melbourne). Aust. Phys.; 7: 51-5(Apr 1970).

Summaries of papers presented at the meeting are given. A session on imaging devices included radionuclide and ultrasonic techniques, flow studies with γ camera, and ultrasonic versus isotope scanning comparisons. Other papers included the use of the Mössbauer-effect to study acoustic vibrations, X-ray spectrophotometry in biological systems, laser hazards, radiation dosimetry, and computer applications in clinical dosimetry and monitoring. (auth) (Australia)

50904 COMPUTER EVALUATION OF MONOENERGETIC NEUTRON IRRADIATIONS IN RADIOBIOLOGY. Bengtsson, L., Gunnar (Brookhaven National Lab., Upton, N. Y.); Goodman, Leon J.; Marino, Stephan A.; Robertson, James S. Health Phys.; 18: 577-8(May 1970).

A computer program written in Fortran-IV and code named ANY (Accelerator Neutron Yield) was developed to compute the mean neutron energy at the center of the presenting surface of the irradiated object, as well as the energy spread, mean kerma rate, and kerma spread on the presenting surface for accelerator produced neutrons. (UK)

50905 SIMPLE PATIENT DOSE CALCULATOR FOR RADIOGRAPHIC EXPOSURES. Williamson, B. D. P. (National Radiation Lab., Christchurch, N. Z.). Australas. Radiol.; 14: 200-5(May 1970).

The parameters determining the radiation dose to the skin of the patient in radiographic exposures are discussed as the basis for the development of a simple, easily-operated calculator.

Operational instructions are outlined and two examples are given. (auth) (Australia)

50906 STATIONARY AND MOVING FIELD DOSAGE DISTRIBUTIONS WITH AND WITHOUT THE COMPUTER. A NEW CONCEPT IN THERAPY PLANNING. Ingram, K. W. (Perth Radiological Clinic, Australia). Radiographer; 17: 6-14(Jun 1970).

A library of isodose patterns, one hundred percent normalized at the center of rotation, was built up. A suitable distribution selected from this library and arranged on a cross sectional outline of a patient enables the distribution to be drawn upon the cross section. The absolute dose can be calculated for each field by means of tissue air ratios. (Australia)

50907 STATIONARY AND MOVING FIELD DOSAGE DISTRIBUTION WITH AND WITHOUT THE COMPUTER. A SYSTEM OF MOVING FIELD DOSAGE CALCULATION FOR THE BUSY DEPARTMENT. Ingram, K. W. (Perth Radiological Clinic, Australia). Radiographer; 17: 25-30(Jun 1970).

A system of calculation of moving field distributions is presented. Allowance for oblique incidence and shape correction is made, and accurate, detailed results are obtainable. Superimposition of a normal isodose chart on a series of polar axis grids for a particular sweep of arc under consideration enables totalling and averaging of dosages on each grid point. Computer access is not essential. (Australia)

50908 DOSE DISTRIBUTION FROM INTRACAVITARY RADIUM AND SUPPLEMENTARY EXTERNAL IRRADIATION WITH REGARD TO TOPOGRAPHY OF LYMPH NODES IN CARCINOMA OF THE UTERINE CERVIX. Joelsson, J.; Baeckstroem, A.; Diehl, J.; Lagergren, C. (Radiumhemmet, Stockholm, Karolinska Sjukhuset, Stockholm). Acta Radiol., Ther., Phys., Biol.; 9: No. 1, 33-54(Feb 1970).

A series of patients with carcinoma of the uterine cervix treated by combined ^{226}Ra implant and ^{60}Co beam γ therapy examined with lymphography, phlebography, LiF dosimetry, and localization of the target volume disclosed that the pelvic wall dose from intracavitary ^{226}Ra treatment was small and that the three beam technique for external ^{60}Co γ beam irradiation failed to include the lymph nodes along the external iliac vessels. This finding necessitates a modification of the technique. A redistribution of the loads of the three beams or the addition of high energy electron beams is suggested. (auth) (Sweden)

50909 HOW MANY RADS PER PATERSON–PARKER ROENTGEN? Porter, E. H. (New York Univ., N. Y.). Brit. J. Radiol.; 43: 629-37(Sep 1970).

A comparison was made between the average rad dose delivered by planar radium treatments and the roentgen dose derived from the Paterson–Parker tables. The relationship shows anomalies, some of which can be explained. It appears that the prescription of N Paterson–Parker R leads to the delivery of 0.92N rad, or very nearly. This value, 0.92 rad, is also serviceable for volume inplants. A change from the roentgen to a well-defined unit of absorbed dose is regarded as desirable. The change can be made with the least possible disruption of clinical practice by redefining the Paterson–Parker R as 0.92 rad. This redefinition is recommended, and the effect of it on the Paterson–Parker tables is shown. Gynaecological radium treatments pose different problems, and are neither discussed here nor included in this recommendation. (auth) (UK)

50910 RADIATION PROTECTION STUDY ON THE MEDICAL RADIATION FACILITIES. Moon, Suc Hyong (Radiological Research Inst., Seoul). J. Nucl. Sci. (Seoul); 10: No. 1, Pt. 2, 85-9(Jun 1970). (In Korean).

Concern over gonadal radiation exposure is universal, and limiting values for such exposure have been recommended for whole populations. The major peace time sources of gonad exposure of whole populations are natural radiation and diagnostic and therapeutic application of radiation. A formula is presented for calculation of the genetically significant radiation dose for man. Measurements were made of the gonadal doses from diagnostic radiography of adults in Korea in six divided regions of the body. The fertility factors were computed from the vital statistics of the Korean population. The calculated genetically significant dose to the Korean population arising from x ray diagnosis was 27.47 mRem/year in 1968. This figure includes the contribution from the mass survey examinations of the chest. (auth)

50911 USE OF EFFECTIVE ENERGY TO CALCULATE ABSORBED DOSE. Cowdrey, E. J. K.; Galand, Claude; Charlton, D. E. (Sir George Williams Univ., Montreal). Phys. Med. Biol.; 15: 541-7(Jul 1970).

The absorbed dose in water, aluminum and copper is calculated from photon spectra, as well as from their corresponding single effective energies, for eight photon spectra with peak energies from 45 to 105 kv. The ratio of effective energy dose to spectrum dose, which should be 1.00 if the single effective energy is equivalent to the spectrum, is then re-evaluated as each photon spectrum is hardened theoretically. For water the ratio of absorbed doses remains very close to 1.00; for aluminum and copper it deviates by as much as +16% and +22% respectively. It is shown that filtrations producing ratios of effective energy to peak energy greater than 0.7 are necessary to obtain an accuracy better than 5%. Dose distributions near an aluminum/water interface calculated for photon spectra and effective energy are also presented. (auth) (UK)

50912 CONSIDERATION OF BODY HETEROGENEITIES IN ELECTRON THERAPY OF TUMORS. Khvan, G. V.; Nurmanov, M. Sh.; Azhigaliev, N. A. (Kazakh Scientific-Research Inst. of Oncology and Radiology, USSR). Med. Radiol.; 15: No. 5, 54-63(May 1970). (In Russian).

Body heterogeneities exert an essential influence on the dose distribution in irradiation with high-energy electrons. Correction coefficients are proposed for body heterogeneities that were derived with the aid of semiempirical formulas. By means of a miniature ionization chamber dosimetric measurements were made in homologous and heterogeneous phantoms from aluminum, sulfur, magnesium, foam plastic, and polystyrole imitating the muscular tissue, bones, and lungs. Concrete correction coefficients of the influence of bone, lungs, and air layer on the dose distribution during irradiation with betatron MeV electrons are depicted. (auth)

50913 DOSE FIELD CREATED BY PROTON BEAM IN THE IRRADIATED BODY. Vainberg, M. Sh.; Dmitrievskii, I. M.; Semenov, Yu. V.; Telkov, Yu. N.; Frolov, V. V.; Sharapov, B. N.; Astrakhan, B. V.; Salamov, R. F. (Moscow Inst. of Engineering Physics). Med. Radiol.; 15: No. 5, 69-73(May 1970). (In Russian).

The method used for the calculation of dose fields created in the irradiated body by a medical proton beam is discussed. The results of the experiment concerned with the determination of the influence on the dose field of heterogeneities and curvature of the body surface are given. (auth)

50914 METHODS OF PROGRAMMATIC IRRADIATION OF MALIGNANT TUMORS IN MOBILE TECHNIQUES OF TELEGAMMATHERAPY. Ermakov, V. I.; Videnskii, V. G.; Mardynskii, Yu. S.; Goldobenko, G. V. (Inst. of Medical Radiology, Moscow). Med. Radiol.; 15: No. 5, 77-80(May 1970). (In Russian).

Possible ways of optimization of irradiation conditions for malignant tumors using mobile ^{60}Co telegammatherapy techniques by the use of isodose curves are discussed. The elaboration of such a system is based on the use of the effect of separate parameters (rotation, source rate, source-focus distance, dimensions of the axial field) on the formation of the dose field. It is expected that such a system would make it possible to achieve an optimal ratio between the dose in the tumor and the dose of whole-body irradiation of the patient. (auth)

50915 MONTE-CARLO TECHNIQUE AS AN APPLICATION TO THE CALCULATION OF ABSORBED DOSES IN RADIUM TREATMENT. Ivanov, V. N. (Inst. of Medical Radiology, Moscow). Med. Radiol.; 15: No. 5, 81-6(May 1970). (In Russian).

Some modifications of the Monte-Carlo technique are presented that are applicable to calculation of absorbed dose of γ radiation during radium implant therapy. The general principles and practical problems of dose calculations are discussed. The formulas presented may be utilized in the solution of different problems of medical radiology and radiobiology. (auth)

50916 DOSE DISTRIBUTIONS IN ECCENTRIC ROTATION GAMMA-IRRADIATION. Belov, S. A.; Kaveshnikova, S. V.; Sizov, P. P.; Ratner, T. G. (Inst. of General Genetics, Moscow). Med. Radiol.; 15: No. 5, 86-93(May 1970). (In Russian).

A method is described for the calculation of dose fields during eccentric rotation γ irradiation using rotation of the γ apparatus with a 75 cm radius of rotation. The dose distribution was calculated in a homogenous cylindrical phantom 30 cm in diameter. The regularities of alteration of the position of the maximal dose region depending upon the angle of rotation, width of field, and eccentricity were determined. (auth)

50917 HANDBOOK OF RADIOACTIVE NUCLIDES. Wang, Yen (ed.). The Chemical Rubber Co. Handbook Series. Cleveland; Chemical Rubber Company (1969). 972p. $27.50.

Separate abstracts were prepared for nine of the ten sections in this book. The other section presents 20 tables of reference

data of interest to the user of this handbook. An extensive subject index is included. (E.R.B.)

For abstracts of individual sections see: 50530, 50574, 50670, 50918, 50934, 50961, 50994, 51776, and 52632.

50918 RADIATION DOSIMETRY. pp 165-225 of Handbook of Radioactive Nuclides. /Wang, Yen (ed.). Cleveland; Chemical Rubber Company (1969).

The units, terms, quantities, symbols, notations, constants and equations used in calculating the absorbed dose in various tissues of the human body following radioisotope administration are given. Absorbed doses from a point source in various shaped containers are calculated, and the data are presented in tabular form. The concentration of activity as a function of time is discussed and the equations for calculating cumulated activity and cumulated concentration are derived. Tables of human anatomic and metabolic data and average radiation doses received by different organs of adult males following administration of 1 μCi of various radioisotopes are also presented to aid in the calculation of absorbed dose. (E.R.B.)

50919 PHYSICAL BASIS AND PRACTICAL ASPECTS OF THERAPY WITH HIGH-ENERGY ELECTRONS. Vogel, K.-H. (Univ., Tuebingen, Ger.). Roentgenpraxis; 23: 180-91(Aug 1970). (In German).

Based on literature references and own studies, a survey of physical principles is outlined for therapy with high-energy electrons. With respect to dose distribution of high-energy electrons, discussed are those factors that are inherent in the equipment and those that result from an interaction between beam and material. In addition, methods for achieving special patterns of dose distribution are analyzed. Knowledge of the various factors is a necessary precondition for radiotherapeutic application of high-energy electrons. (tr-auth)

50920 SPECTRA OF HIGH-ENERGY ELECTRON BEAMS IN WATER. Kessaris, Nikitas D. (Sloan-Kettering Inst. for Cancer Research, New York). Contract AT(30-1)-910. Radiat. Res.; 43: 281-7(Aug 1970).

The spectra of electrons in the energy range 10-20 MeV incident on water are obtained theoretically by solving the appropriate transport equation by the moment method. The spectra of the primary (incident) electrons as a function of depth are obtained first, and they subsequently serve as the source of secondaries for which an analogous equation is solved. (auth)

50921 ABSORBED DOSE AND CAVITY IONIZATION FOR HIGH-ENERGY ELECTRON BEAMS. Kessaris, Nikitas D. (Sloan-Kettering Inst. for Cancer Research, New York). Contract AT(30-1)-910. Radiat. Res.; 43: 288-301(Aug 1970).

The variation of the ratio of absorbed dose to cavity ionization with the depth of penetration of high-energy electron beams in water and carbon media is calculated. Most of the variation is shown to arise from the density effect, present at relativistic energies in liquid and solid media but not in gases. Combinations of theoretical and experimental spectra were used at various depths of interest. The spectra include the contributions of secondary and higher order electrons, which are shown to influence the results substantially. The effect of gas size and gas and wall mismatch are briefly analyzed. (auth)

50922 AERIN, A CODE FOR ACUTE AEROSOL INHALATION EXPOSURE CALCULATIONS. Voilleque, Paul G. (Atomic Energy Commission, Idaho Falls, Idaho). Health Phys.; 19: 427-32(Sep 1970).

AERIN is a FORTRAN IV program written to simplify the application of equations for computing the organ and tissue burdens and doses resulting from an acute inhalation exposure to a radioactive aerosol. The models which form the basis for the calculations are the deposition and clearance models of the ICRP Task Group on Lung Dynamics, the gastro-intestinal (GI) tract model of Eve, and a single exponential model for the critical organs and tissues. The fundamental data for the respiratory and GI tract models are written into the program. The user can select suitable dosimetric parameters for the respiratory and GI tract tissues, choose the appropriate metabolic and dosimetric quantities to be used in calculations for the critical organs and tissues, and specify the number of computations to be made and the time interval between them. The output consists of a complete listing of the assumed parameters as well as the organ and tissue burdens and doses as functions of time post exposure. (auth) (UK)

50923 ASSESSMENT OF THE RADIATION DOSE TO DEVELOPING FISH EMBRYOS DUE TO THE ACCUMULATION OF RADIOACTIVITY BY THE EGG. Woodhead, D. S. (Fisheries Radiobiological Lab., Lowestoft, Eng.). Radiat. Res.; 43: 582-97(Sep 1970).

A dosimetry model was developed that can be used to estimate the radiation dose received by the developing embryos of the plaice, Pleuronectes platessa, in contaminated environments. The concentration factors for the nuclides $^{144}Ce-^{144}Pr$, ^{137}Cs, $^{106}Ru-^{106}Rh$, $^{90}Sr-^{90}Y$, and $^{95}Zr-^{95}Nb$ were determined experimentally for plaice eggs, and the data used together with the dosimetry model to make estimates of the dose received by the developing embryos in the contaminated spawning ground in the northeast Irish Sea. It was found that the dose rate from the fission nuclide contamination was less than that caused by the naturally occurring radionuclide of potassium. (auth)

50924 CHANGES IN SURFACE TENSION OF BLOOD SERUM AFTER WHOLE-BODY X IRRADIATION. Zak, Miroslav; Hlavaty, Vlastislav (Charles Univ., Prague). Acta Univ. Carolinae, Med.; 15: 531-5(1969).

Radioinduced changes in the physical properties of blood serum were studied from the standpoint of application to biological dosimetry. Variations in the surface tension of blood serum were studied in whole-body x-irradiated rabbits. To assess the influence of post-irradiation time and radiation dose as variables, surface tensions were determined at fixed times after varying doses and at varying time intervals after fixed doses. (P.B.M.)

Radiation Protection

Refer also to abstracts 50866 and 50917.

50925 (AECL-3685) WASTE CONTROL PROBLEMS IN AN EXPANDED NUCLEAR POWER INDUSTRY. Barry, P. J.; Ophel, I. L. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear :Labs.). [1970]. 16p. (CONF-700810-2; SM-146/11). Dep. CFSTI (U. S. Sales Only).

From Symposium on Environmental Aspects of Nuclear Power Stations, New York, N. Y.

Some of the practical difficulties that arise when trying to predict the transfer of radionuclides from the point of release to individual members of the population, particularly that part of the transfer that occurs through food chains, are discussed. The current radiation protection standards applying to the release of radioactive materials from nuclear power stations are considered. It was concluded that there should be a change in emphasis by defining maximum permissible doses and hence release rate, and that the maximum dose rate to the individual should in the future be replaced by a maximum per population dose rate. (D.H.M.)

50926 (LA-4459-TR) COMPARATIVE TESTS OF FINE-DUST MASKS. Regenberg, Fritz. Translated by M. Milligan (Los Alamos Scientific Lab., N. Mex.), from Atemschutz-Inform.; 8: No. 3, 66-71(1969). 8p. Dep. CFSTI.

Comparative tests were carried out with several dust masks according to the specifications of the German Committee for Respiratory Protective Devices of protection level IIa (masks protecting against health-endangering mineral dusts). Not all of the models responded to the specifications concerning the degree of dust removal. (auth)

50927 (LA-tr-70-17) AIRTIGHT FIT OF RESPIRATORY PROTECTION MASKS. Aurich, G. Translated for Los Alamos Scientific Lab., N. Mex., from Atemschutz-Inform.; 8: No. 2, 32-6(1969). 10p. Dep. CFSTI.

The problems of a tight sealing fit of face-masks are of equal importance with respect to the efficiency of devices of respiratory protection as the problems of their functioning. The efficiency of devices for respiratory protection is more limited by insufficient sealing rather than by functional failure or other leaks. An optimal fit of the mask is the prerequisite for a satisfactory seal between mask and face of the bearer of the device. Fit and sealing are in close correlation because adequate sealing with tolerable inconvenience may only be achieved with a good fitting mask. Fit and sealing of face-masks are determined by the ratio between the dimensions and the shape of the mask and the shape and the dimensions of the bearer of the device, by the shape and the material of the sealing frame, by the tape-lapping, and by the forces and moments exerted by the accessories which are attached to it. A final decision on the tight sealing and convenient fit of a mask may only be made after achievement of body conformity and the respective leakage testing. The most essential testing procedures and some results achieved with their application, which are of special importance for the practical use of devices for respiratory protection, are described. (auth)

50928 (TID-25375) OAK RIDGE ASSOCIATED UNIVERSITIES HEALTH PHYSICS MANUAL. (Oak Ridge Associated Universities, Inc., Tenn.). 3 Sep 1965. 210p. Dep. CFSTI.

Forty-one laboratory exercises in elementary health physics, a list of useful constants and conversion factors, a bibliography on

radiation safety in the design of laboratories, and a list of suppliers of specialized supplies for radiochemical laboratories are included in this manual. (C.H.)

50929 RADIOPHARMACEUTICAL PRODUCTION: RADIATION SAFETY. Fredrickson, R. L.; Myers, C. B. Ind. Med. Surg.; 38: No. 7, 29-34(Jul 1969).

Radioactive materials, some of very high toxicity, are handled in large quantities during radiopharmaceutical (labelled drugs) production. Having briefly described the biological effects of radiation and radiation exposure limits, a description is given of how hazards are controlled so as to be no greater than in other industries. Control depends on three factors: time, distance and shielding. Of these, shielding (by lead, special concrete, or very thick glass) is the most important. Protective and remote-control equipment, very careful ventilation, and sound housekeeping are backed up by constant and repeated radiation monitoring. Clothing and equipment also are carefully checked after use and there are elaborate arrangements for waste disposal. (auth)

50930 RADIATION DOSE SURVEY. Chandler, F. R. (Prince Henry's Hospital, Melbourne). Radiographer; 17: 14-19(Jun 1970).

Recommendations for the protection of radiographers and patients, and surveys of population dose are reviewed. Details of a survey to establish the genetic and somatic doses to the Australian population from the medical and dental use of X-rays and ionising radiation are previewed. The format of questionnaires to be used in conjunction with radiographic examinations is discussed in relation to the validity of results. (Australia)

50931 HAZARDS TO THE HUMAN EYE THROUGH LASER EXPOSURE. Kaufmann, E. (Schweizerische Unfallversicherungsanstalt, Lucerne, Switzerland). Schweiz. Arch. Angew. Wiss. Tech.; 36: 211-18(Jul 1970). (In German).

Lasers are hazardous to the human eye; this is especially true for helium and neon continuous lasers of several milliwatt power if the beam directly hits the eye. Use of telescopes reduces the danger but does not eliminate it. When using telescopes the eye should not be directly hit by the beam. Safety is provided by proper protective glasses. The transmission factor of protective glasses must be adapted to the type and arrangement of lasers. Frequently, sufficient protection can be achieved without impairing visibility in the working area. (H.B.G.)

50932 EFFECT OF REGIONAL SHIELDING ON BACTERIAL ENDOCARDITIS IN X-IRRADIATED RATS. Highman, Benjamin (Armed Forces Inst. of Pathology, Washington, D. C. National Institutes of Health, Bethesda, Md.); Hanks, Alan R.; Rantanen, Norman W. Radiat. Res.; 43: 691-7(Sep 1970).

A high incidence of bacterial endocarditis was induced in female rats given two whole-body exposures to 400 R x radiation at 4-day intervals followed by two successive daily subcutaneous injections of epinephrine in oil and two intravenous inoculations of Streptococcus mitis. The high incidence of bacterial endocarditis induced by such treatment was substantially reduced by shielding with lead either the abdomen or the hindlegs; irradiating the abdomen alone did not significantly increase susceptibility, and shielding limited to the duodenal region offered no significant protection. The resistance of the regionally shielded and the abdominally irradiated animals to infection was attributed to the fact that the reduction in leukocyte and platelet counts was much less pronounced than in the unshielded rats or in rats with shielding limited to the duodenal region. These findings indicate that protection of a sufficient portion of the hematopoetic system to prevent severe leukopenia is of primary importance in maintaining resistance, and that irradiating or shielding the intestinal tract were not major factors influencing resistance to infection. (auth)

50933 DEVELOPMENT OF THE QUANTIATIVE BASES FOR RADIATION PROTECTION. Pochin, E. E. (University Coll. Hospital, London). Brit. J. Radiol. 43: 155-60(Mar 1970).

The opening lecture, delivered June 10, 1969, at the International Congress of Radiology, Tokyo, Japan, is summarized. The quantitative bases for the calculation of radiation protection measures are discussed under the following headings: The need for quantitative estimates of hazard; selective irradiation of different tissues; significance of low doses; genetic considerations; comparison of different classes of hazard; evaluation of carcinogenic risk; and further information needed. (UK)

50934 RADIATION PROTECTION AND REGULATIONS. Brodsky, Allen (Univ. of Pittsburgh); Bradley, Francis J. pp 570-833 of Handbook of Radioactive Nuclides. /Wang, Yen (ed.). Cleveland; Chemical Rubber Company (1969).

The biological, legal, mathematical, medical, physical, and radiological aspects of radiation protection and regulation are discussed. The section includes papers on the following topics: basic units of radiation measurement; radiation protection guides and regulatory limits of exposure; data and methods for estimating radiation exposures from internal and external radiation sources; determination of facilities, equipment, and procedures required for various types of operations; personnel dosimetry; transportation of radioactive materials; radioactive-waste disposal; administration of a radiation protection program; and emergency planning and procedures. Procedures and forms for evaluating and recording data relative to radiation incidents are presented in the appendix to this section. (E.R.B.)

Safety Procedures

50935 (AD-705147) DAILY TOTAL-BODY EXPOSURES OF PRIMATES TO PROTON-, X-, OR GAMMA RADIATION: THE HEMATOLOGIC RESPONSE. Final Report, August 1967-August 1969. Sturrock, David; Ballinger, Edwin R.; Traynor, Joseph E. (School of Aerospace Medicine, Brooks AFB, Tex.). Feb 1970. 70p. (SAM-TR-70-1). CFSTI.

In the course of space exploration, man may be exposed to relatively small but significant daily doses of high-energy proton radiation from solar flares. These doses might not be high enough to produce symptoms, but could produce changes in the number of peripheral blood cells. Rhesus monkeys were exposed in groups to daily, pulsed doses of 3-, 5-, 8-, 10-, 15-, or 20 rads from 150-MeV protons. Other groups were similarly exposed to pulsed 300-kvp x-rays. Still others were exposed continuously to cobalt-60 gamma radiation for a total dosage within 22 hours of 5-, 10-, 15-, or 20 rads. Assuming that the ratio of the dynamics of the changes in the peripheral blood counts from pulsed proton exposures (Pp) to those from pulsed x-rays (Px) would be the same as the ratio of the dynamics of the changes in the peripheral blood counts from continuous proton exposures (Cp) to those from continuous gamma exposures (Cg) (i.e., Pp : Px = Cp: (Cg), the unknown (Cp) could be deduced. Results suggest that the ratio Pp : Px is exceedingly close to unity, and that the ratio of Pp (or Px): Cg is between 1.5 and 1.6 to 1. Consequently, the effect of continuous proton exposure within these daily dose increments can be predicted. (auth) (STAR)

50936 (BRH/DEP-70-23) MICROWAVE OVEN TEST LOAD EVALUATION AND DETERMINATION OF INTERNAL MICROWAVE ENERGY DISTRIBUTION. Levine, Harry; Moore, Robert L. (Bureau of Radiological Health, Rockville, Md. Div. of Electronic Products). Aug 1970. 25p. CFSTI.

The variables that must be considered in any test procedure used to measure radiation leakage from microwave ovens were investigated. An evaluation was made of the effect of various factors involved in such measurements, including load temperature, size and shape of containers for the load, water load repeatability, and the suitability of loads other than water. A study was also made of the distribution of microwave patterns in an oven using sponge substrate impregnated with hydrated cobaltous chloride. The chemically impregnated sponge test could be a very helpful aid in determining the test load position in order to create the condition of worst possible leakage from a microwave oven. (auth)

50937 (CEA-Bib-182) STUDY OF TRITIUM HAZARDS. Vaubert, Bernadette; Bittel, Robert (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Sep 1970. 47p. (In French). (EUR-4522). Dep. CFSTI (U. S. Sales Only).

In this bibliography the following points were considered: nuclear characteristics, tritium production processes and resulting potential hazards; tritium behavior towards hydrogen and several hydrogenated compounds; detection and radiochemical determination; environmental transfers, with emphasis on tritium behavior in the presence of atmospheric water and in various aquifer systems; some biological considerations of absorption, inhalation, and dosimetry; and radiobiology in order to characterize effects caused by the nuclear characteristics of tritium. (France)

50938 (CEA-CONF-1514) HUMAN FACTOR IN ACCIDENTS TO PERSONNEL IN THE NUCLEAR FIELD. [Sutra-Fourcade, Y.] (Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule). 1969. 15p. (In French). (CONF-691211-1). Dep. CFSTI (U. S. Sales Only).

From Symposium on Education and Training of Workers in Radioprotection, Brussels, Belgium.

A detailed study of the accidents known to have occurred since the beginning of the nuclear era shows that to a very large extent their causes are of human origin: lack of technical knowledge of the material and method used; lack of theoretical knowledge of the nature of radiations and their biological effects; ignorance of

elementary ideas on radiation shielding safety signaling, regulations concerning the use of artificial radioelements or x-ray generators; absence or poor functioning of detection instruments because of lack of maintenance; manipulations badly prepared and carried out; failure to comply with instructions or safety signals; forgetfulness or underestimation of danger, negligence, and inattention; voluntary disconnecting of safety devices; human factor, which means that the quick, easy and unobtrusive way of repairing the consequences of a mishap (sometimes caused by a blunder) often takes precedence, particularly in the absence of those in charge, over the normal procedure that demands the installation of certain safety devices. It is observed that lack of training and information affects all categories of personnel. To the criteria of training and information it is thus necessary to add strict obedience to instructions, sustained attention, and especially safety-mindedness. (auth) (France)

50939 (CONF-691212-, pp 369-86) DOSE AND DAMAGE IN LONG-TERM RADIUM CASES. Rowland, R. E. (Argonne National Lab., Ill.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8-11, 1969.

The experience with radium in dial painters and medical cases is reviewed. For this purpose, the total patient population in the Argonne National Laboratory and Massachusetts Institute of Technology studies was combined. The modification of the Norris retention function by Marshall is shown to fit the existing retention data remarkably well. Various methods of dose calculation are considered, ranging from average skeletal doses to microscopic dose distributions as they actually exist in bone. The German experience with ^{224}Ra is compared with the United States experience with ^{226}Ra. The data of Spiess and Mays show that ^{224}Ra is about 13 times more effective than ^{226}Ra (rad for rad) in producing tumors. The localization of the two isotopes is suggested as the reason for this marked difference. (auth)

50940 (UCRL-Trans-10471) ACCIDENTS IN ATOMIC INSTALLATIONS. Hattori, M. Translated by T. Sakuragi for Univ. of California Lawrence Radiation Lab., Livermore, from Genshiryoku Kogyo; 15: No. 3, 20-2(Mar 1969). 11p. Dep. CFSTI.

Two-hundred and seventy-four accidents in atomic reactors reported between 1945 and 1967 were analyzed as to number of reactors involved, country in which located, and type of accident. Radiation accidents not involving reactors are also discussed briefly. (C.H.)

50941 HEALTH EDUCATION IN THE CZECHOSLOVAK URANIUM INDUSTRY. Nedvidek, A. Cesk. Zdrav.; 18: 40-3(Jan 1970). (In Czech).

The development of health education in the Czechoslovak uranium industry is described and problems that ensue from the specific character of work in this branch (mines and chemical plants) are analyzed. In addition to general hazards is the hazard of ionizing radiation, i.e., external and internal radiation. Health education is focused above all on these specific hazards, which are elaborated in the form of instructions for doctors. The cooperation with senior workers and trade union authorities in the plants is important. Forms and types of activities that proved most useful are analyzed. In the future it will be necessary to focus attention also on hygiene and safety of work, the dust rate, injury rate, catering, and other specific conditions; by means of sociological investigations a certain overall view on the health consciousness of the employees should be obtained, and based on it, mistakes should be demonstrated as well as ways to improve health education in future. (auth)

50942 ISOTOPES IN RADIOTHERAPY: MEDICAL AND ENGINEERING CONSIDERATIONS. Shapiro, J. S.; O'Connor, A. D. Proc. Inst. Mech. Eng. (London); 184: 417(1969-70).

The Servotec Canterbury teletherapy unit is described. The merits of the chosen combined shielding design are explained and the geometry of the radiation head is given including the source movement mechanism. The problem, basic principle and engineering embodiment of the radiation beam definition and control mechanism are discussed. The fundamental approach and engineering solutions of the radiation head alignment system are described. The remote control of the unit and the treatment sequence are briefly reviewed. Radioactive isotopes suitable for use in large treatment units in radiotherapy are reviewed with special reference to ^{60}Co. In comparison with X-ray generators of such quality, such units are more reliable. The features of design of a unit desirable for isotope teletherapy are set out. The methods of treatment planning and execution are described and the advantages obtained from the Servotec Canterbury unit enumerated. (auth) (UK)

50943 EFFECT OF INTERMITTENT INFRARED RADIATION ON THE STATUS OF NATURAL IMMUNOLOGICAL REACTIVITY OF WORKERS. Zelentsova, S. P. Gig. Tr. Prof. Zabol.; 14: 22-6(Jan 1970). (In Russian).

Some indices characterizing natural immunological reactivity of the workers' organism were studied. The disease incidence of so-called "bad cold forms" occurring consequent to different modalities of infrared irradiation with equivalent summary dosage of the received heat was also studied. A long-term exposure of workers to the effects of infrared radiation with intensity of 1 to 3 cal/cm^2/min in combination with high intermittance showed an adverse effect on the state of immunological reactivity, increasing the incidence rate of "bad cold forms" among workers. Intermittent infrared irradiation of low intensity (0.5 to 0.7 cal/cm^2/min) acted as a stimulant and increased the protective forces of the organism against unfavorable environmental factors. (auth)

50944 ERYTHROCYTES OF URANIUM MINERS: THE ACTIVITY OF THE PENTOSE PHOSPHATE PATHWAY. Vich, Z.; Novosad, F.; Brychtova, V. (Health Inst. of Uranium Industry, Pribram, Czech.). Brit. J. Ind. Med.; 27: 287-90(Jul 1970).

The functioning of erythrocytes was studied by determination of the activity of the pentose phosphate pathway in 431 individuals-221 uranium miners, 42 employees of a uranium ore trimming station (30 of whom were exposed), 36 former uranium miners, 32 coal miners, and 100 persons not working in mines and with no previous exposure. In the groups exposed to long-term occupational radiation, the activity of the pentose phosphate cycle was found to be enhanced. This finding was interpreted as evidence for a change in the functional state of the erythrocytes in exposed persons due to the effects of radiation on the genesis of red cells in the bone marrow. (auth)

50945 RADIATION CONDITIONS AT NUCLEAR POWER PLANTS. Anan'ev, E. P. Sb. Tr., Mosk. Inzh.-Stroitel. Inst.; 56: 101-8(1968). (In Russian).

After 10 years experience with nuclear power plants, radiation dangers have not materialized and can be considered to be relatively slight. An analysis of radiation readings at the Dresden plants show a few places with high readings, but personnel can be kept away from these spots. The personnel receive an annual dose of less than 5 rem, which is a safe dose. The water in the primary circuit is purified to a high degree in order to decrease the amount of induced radioactivity. Other liquid radioactive wastes are controlled either by purifying by ion exchange or with the use of evaporation. The radioactivity in the air is decreased by means of filtration, and by holding the gases in a retention tank where short-lived activities are allowed to decay before being discarded. Radiation levels in nuclear power plants can be controlled by means of proper design. (TTT)

50946 COMMENTARY ON: HEALTH OF WORKERS IN THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY BY K. P. DUNCAN AND R. W. HOWELL. Sanders, B. S. Health Phys.; 19: 321-22(Aug 1970).

Comment is made concerning the basis on which the mortality rate of UKAEA personnel was judged in the article (Health Phys., 19: 285-291(Aug 1970)). It is stated that the death rate of those in employment is always lower than that of the general population and that a more meaningful comparison could have been made between UKAEA workers with radiation exposures of specified degrees and those with none. The comparative figures of non-manual to manual workers are discussed. (auth) (UK)

Civil Defense

50947 (SZS-9/70) CONFERENCE OF THE GERMAN-POLISH WORK GROUP FOR THE SURVEILLANCE OF THE RADIOACTIVE CONTAMINATION OF THE ENVIRONMENT, BERLIN, JUNE 16-21, 1969. PART I. Moldenhawer, F.; Bose, H.; Korsetz, B. (comps.) (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). May 1970. 29p. (In German). Dep. CFSTI (U. S. Sales Only).

Basic problems of radiation protection in emergency situations are analyzed. Emphasized are civil defense aspects in the case of nuclear warfare. Also discussed are problems of environmental monitoring in the case of accidents involving nuclear power stations. Emergency procedures for contamination measurements are outlined for foodstuff, water, air, and the population. Three different types of instruments for radiation monitoring of γ-doses emitted by contaminated surfaces and liquids are described. Laboratory procedures for determination of radioactivity in the case of nuclear emergencies are presented. (H.B.G.)

Legal Aspects

50948 LEGAL ASPECTS OF THE USE OF IONIZING RADIATION SOURCES. de los Santos Lasurtegui, Alfonso; Corretjer Palomo, Luz (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 13: 431-40(Sep-Oct 1969). (In Spanish).

The judicial problems connected with the use of ionizing radiation sources are related to two fundamental questions: the prevention and repair injuries that can be caused by radiation. The necessity for judicial guides is outlined. The scope and content of nuclear legislation in various countries is compared with that of Spain. The Spanish nuclear law is outlined in some detail with a consideration of prevention of injury and recovery if exposure occurs. The injury covered by the legislation, the liability, and the injurer are discussed. (J.S.R.)

50949 POINT OF VIEW OF AN INSURER ON THE DEVELOPMENT OF SAFETY SYSTEMS IN NUCLEAR INDUSTRIES. Deprimoz, Jacques (Pool Francais d'Assurances des Risques Atomiques, Paris). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 81, 29-36(Jan-Feb 1970). (In French).

The problems of the radioprotection norms to be respected and of what is sometimes called the accepted risk are discussed from an insurance viewpoint. A study of the field in which insurance is involved, in the form of civic operator responsibility policies covering third-party damages and material damages policies covering damage to the plant, is followed by suggestions for practical measures applicable on the site to ensure maximum safety of the facilities. The tariff policy suggested to atomic insurers by the last twelve years experience is reported. (France)

50950 NUCLEAR HAZARDS AND CIVIL RESPONSIBILITIES. de los Santos Lasurtegui, Alfonso (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 13: 261-70(May-Jun 1969). (In Spanish).

The guarantee of the insurance or financier as covered by the civil laws and international conventions and administration of the laws is discussed. The intervention of the state in the case of a nuclear accident and the ways in which it participates in the indemnification of the injured party are also considered, both with respect to international conventions and Spanish civil law. (J.S.R.)

Medicine

Refer also to abstracts 50524 and 50917.

Protective Substances

Refer also to abstracts 50705, 50709, 50714, 50758, 50849, 50868, 51028, 51033, 51036, 51059, 51065, and 51100.

50951 APPLICATION OF RADIOPROTECTANTS DURING SIMULATED RADIATION DAMAGE OF EXTENDED SPACE FLIGHT. Rogozkin, V. D.; Sbitneva, M. F.; Shapiro, G. A.; Gvozdeva, N. I.; Zukhbaya, T. M.; Zubenkova, E. S.; Zueva, V. A.; Burkovskaya, T. E. Kosm. Biol. Med.; 4: No. 2, 20-4(Mar-Apr 1970). (In Russian).

Results are presented of a year-long observation of dogs exposed to chronic irradiation (75 rem/year) and repeated acute irradiations (50 rem three times per year). They were given ATP and complex preparation amytetravit to prevent possible disturbances of various organs and systems. The drugs appeared to exert a normalizing effect on the hemopoietic function. (auth)

50952 NEW DATA ON THE TOXIC AND RADIOPROTECTIVE EFFECT OF CYSTEINE ON ESCHERICHIA COLI 15 T⁻ CELLS. Nagy, Z.; Kovacs, P.; Kari, C.; Hernadi, F. (Univ., Debrecen, Hungary). Arch. Mikrobiol.; 70: 65-71(1970).

Exponential phase cultures of Escherichia coli 15 T⁻ cells growing on glucose-mineral medium were supplemented with 2 mM l-cysteine-HCl. The optical density, acid soluble SH (AS-SH) as well as the DNA, RNA, and protein synthesis of the cultures were examined during this treatment and after return to normal growth conditions. Similarly, the survival of cells irradiated by a standard x-ray dose in cysteine-free buffer was measured. The development of radioresistance during the cysteine treatment as well as the loss of this acquired radioresistance after return to normal growth conditions could be divided into two phases: a) an instantaneous and b) a slow change of radioresistance. Phase "a" seems to be related to the changes occurring in the AS-SH content of the bacteria, while phase "b" is apparently dependent on the alterations in the synthesis of macromolecules. (auth)

50953 BIOLOGICAL BASIS FOR DETECTION OF MALIGNANT TUMORS BY SELECTIVE FIXATION OF RADIOACTIVE INDICATORS. Plagne, R.; Meyniel, G. (INSERM, Clermont-Ferrand, France). Rev. Fr. Etud. Clin. Biol.; 14: 1036-53 (Dec 1969). (In French).

The alterations of the circulation and tissue exchanges or, more rarely, the modifications of the cellular metabolism explain in part the tumor accumulation of very diverse molecules so that radioactive labeling is applicable to diagnosis and even to metabolic radiotherapy. Although the abnormal concentrations of these indicators are not specifics of malignant tumors, the very prolonged persistence of the hyperactive focus or center or its progressive accentuation are evocative characteristics. A certain number of factors capable of increasing artificially the fixation and research with new molecules extend the applicability of these methods. 222 references. (tr-auth)

50954 EFFECT OF SULPHYDRYL PROTECTOR AND RADIOSENSITIZER ON DEOXYCYTIDINE FORMATION IN RAT THYMUS. Sheremet'evskaya, T. N.; Filippovich, I. V.; Romantsev, E. F. (Inst. of Biophysics, Moscow). Vop. Med. Khim.; 16: 437-40(Jul-Aug 1970). (In Russian).

Intraperitoneal administration of β-mercaptoethylamine cysteamine and radiosensitizer (β-mercaptoethanol) into rats lead to sharp inhibition in deoxycytidine formation in thymus extracts. The maximal inhibitory effect of radioprotector was noted 15 to 30 min after the injection and was reversible. The inhibitory effect of radiosensitizer was noted during all time intervals studied (up to 2 hr after administration). On the base of experimental data it may be supposed that the temporal inhibitory effect of protector was conditioned by the formation and dissociation of mixed disulfides of β-mercaptoethylamine with proteins of thymus extract, and with the enzymatic system catalyzing deoxycytidine formation. (auth)

50955 RADIOPROTECTIVE ACTIVITY OF AMINOTHIOLS (CYSTAMINE) AS A FUNCTION OF THE DOSE OF THE PREPARATION AND PERIOD OF ITS USE UNDER VARIOUS CONDITIONS OF γ IRRADIATION. Vasin, M. V.; Saksonov, P. P.; Shashkov, V. S.; Antipov, V. V. Radiobiologiya; 10: 380-5 (May-Jun 1970). (In Russian).

The radioprotective properties of various doses of cystamine were studied in mice as functions of duration of drug administration and radiation dose rate. A linear relationship existed between the radioprotective effectiveness of compound dose and the radiation dose rate between 139 and 159 R/min. Dynamics of radioprotective properties of the protector were followed for a period of 12 hrs after parenteral administration. The radioprotective effects of cystamine were compared after irradiation for 5 to 7 minutes, and 1½, 3, 4, and 8 hrs. (JPRS) (TSS)

50956 RADIOPROTECTIVE ACTION AND METHEMOGLOBIN FORMATION IN THE CASE OF THE JOINT USE OF SULFUR-CONTAINING PROTECTORS AND PARAAMINOPROPIOPHENONE. Kuznetsov, V. I.; Tank, L. I. (Military Medical Academy, Leningrad). Radiobiologiya; 10: 444-6(May-Jun 1970). (In Russian).

Additive radioprotective effects of PAPP and sulfur-containing protectors (cystamine and cystaphos) were not observed in experiments on mice and rats. The radioprotective activity in the joint action of paraaminopropiophenone and cystamine depends upon the methemoglobin content of the blood of the animals. (tr-auth)

50957 INVESTIGATION OF THE ROLE OF ENDOGENOUS THIOLS IN THE PROTECTION OF THE CHROMOSOME APPARATUS OF THE CELL BY CYSTEAMINE. Tarasenko, A. G.; Gusareva, E. V.; Graevskii, E. Ya. (Inst. of Developmental Biology, Moscow). Radiobiologiya; 10: 373-9(May-Jun 1970). (In Russian).

The influence of cysteamine on the radiosensitivity of chromosomes of Ehrlich's ascites carcinoma cells was studied in relation to acid-soluble thiol content. Cysteamine-induced radioresistance was correlated to increased levels of nonprotein thiols (NP-SH). By thin-layer paper radiochromatography and gel electrophoresis cysteamine was shown to comprise no more than 6% of the total NP-SH and about 12% of the increased thiol levels of cells. Total NP-SH was directly correlated with the radioresistance of the cells. On the contrary, endogenous unbound cysteamine affected radiosensitivity only slightly. (JPRS) (TSS)

50958 VARIANCE IN HAMSTER POUCH CARCINOGENESIS IN TISSUE IRRADIATED WITH 200 KVP X-RAYS AND ^{60}Co X-RAYS. Shklar, Gerald; Meyer, Irving; Stevens, Walton; Turbiner, Steven (Tufts Univ., Boston. Western Massachusetts Hospital, Springfield). Oral Surg., Oral Med., Oral Pathol.; 30: 431-7(Sep 1970).

In ninety Syrian hamsters, divided into six groups, twenty animals were irradiated with 1,530 R of ^{60}Co γ rays and twenty animals were irradiated with 1,530 R of 200 kVp x rays prior to three weekly applications of 9,710-dimethyl-1,2-benzanthracene (DMBA) to the right buccal pouches. The radiation was applied as a single continuous dose limited to the area of the right cheek and jaws. Control groups for the DMBA application and the two modalities of radiation were studied. Cobalt-60-irradiated hamsters developed carcinomas at a rate similar to the control animals. Animals irradiated with 200 kVp x rays developed carcinomas later than their controls. This retarded carcinogenesis in the orthovoltage group was interpreted in terms of the DMBA acting upon tissue, with degenerative alterations induced by the 200 kVp radiation, that is, the radiobiologic effect resulted in a slowing of the chemobiologic effect. (auth)

50959 PROTECTION AGAINST X-IRRADIATION EMPLOYING CYSTEAMINE DERIVATIVES IN TISSUE CULTURE AND IN MICE. Vos, O. (Medical Biological Lab., Rijswijk, Netherlands); Grant, G. A.; Budke, L. Int. J. Radiat. Biol.; 18: 111-26(1970).

Series of aminoalkanethiols were investigated to determine their toxic behavior and radioprotective activities at the cellular level in cultured human cells and in mice. The non-linear relationship between thiol concentration and survival of cells found in the concentration range of 0.2 to 8 mM under the present experimental conditions was also pH dependent. The toxicity of the thiols increased with an increase of pH from 6.3 to 8.3. However, the non-linear relationship between concentration and survival was not evident at pH 6.3. Increasing the pH of the cysteamine solution injected intraperitoneally in mice increased toxicity at the rate of 10.3 + 4.6 mg/kg per pH unit. The protection against x-irradiation with aminoalkanethiols in vitro was pH dependent. The pH optimum was dependent on the chemical structure of the aminoalkanethiol. In non-protected cells and in cells protected with dimethyl sulphoxide, it was also observed that radiation sensitivity was affected by pH. No influence of pH on protection was found when cysteamine solutions adjusted over a pH range of 2 to 10 were injected intraperitoneally into mice. The studies on the relationship between chemical structure and activity showed that replacing an H atom in cysteamine by an alkyl group or increasing the distance between the amino and the sulphydryl groups diminished the protective activity of the compound both in vitro and in vivo. Protection is also influenced by the position of the H atom replaced by an alkyl group. The level of protection obtained in vitro by cysteamine was superior to that of any of the cysteamine derivatives. However, in mice some of the derivatives were as effective as cysteamine. Diammonium amidophosphorothioate was not protective in cell cultures. It is proposed that these compounds produce pharmacological effects which lead to protection. A tentative explanation is proposed for the non-linear relationship found between thiol concentration and cell survival. (auth) (UK)

Radiation Sickness and Injuries

Refer also to abstract 50906.

50960 POSSIBILITIES OF REPARATIVE SURGERY IN CUTANEOUS LESIONS CAUSED BY RADIATIONS. Ambroggio, G.; Benedicenti, A. (INAIL, Turin). Minerva Chir.; 25: 412-8 (15 Mar 1970). (In Italian).

A brief account of skin changes caused by ionizing radiation is followed by the indication of extensive tissue resection and repair with pedicled grafts as the fundamental surgery of choice. Six personal cases are described, together with photographs, as an illustration of the functional and cosmetic results that can be obtained. (auth)

50961 RADIATION INJURY AND ITS MANAGEMENT. Wald, Niel (Univ. of Pittsburgh). pp 835-941 of Handbook of Radioactive Nuclides. /Wang, Yen (ed.). Cleveland; Chemical Rubber Company (1969).

The medical and radiological aspects of radiation injury and its management are discussed. Standard man is discussed in terms of organ size and mass and radioisotope clearance rates from lungs and gastrointestinal tract. The response of cells, tissues, organs, and systems, as well as the whole-body response of man to injurious radiation exposures is also discussed. The medical management of radiation emergencies is discussed in terms of immediate emergency procedures, patient care, diagnostic procedures, and clinical management. (E.R.B.)

Radiodiagnosis

Refer also to abstracts 50569–50571, 50574–50576, 50667, 50694, 50755, 50874, 50881, 50882, 50884, 50886, 50890, 50894, 50903, 50905, 50910, 50930, and 51076.

50962 (ACRH-1000-201) ANALOG METHODS OF DATA STORAGE. Beck, R. N.; Charleston, D. B.; Zimmer, L. T.; Beckman, F. H. (Argonne Cancer Research Hospital, Chicago, Ill.). [1970]. 24p. (CONF-700516-3). Dep. CFSTI.

From 1st Biennial Conference on Quantitative Organ Visualization in Nuclear Medicine, Miami, Fla.

The formation of a diagnostically useful image of the distribution of radioactive material that has been administered to a patient requires a radiation detector and a medium for storing the detector output, at least temporarily, for inspection and/or analysis by a physician. In most cases a permanent record is made of the stored image, to be used later for analysis or processing. In general, the output pulses from the radiation detector may be transformed in various ways to provide a suitable input to the storage medium. In digital systems, these pulses are counted, so that the stored image at each point consists of a discrete numerical value associated with a discrete neighborhood about the point. In analog systems, the stored image at each point is represented not by a number, but by the magnitude of some physical entity averaged over a neighborhood about the point. The physical entity may be blackness of paper, film density, light intensity, electrical charge density, or magnetic field strength, the average magnitude of which can vary in an essentially continuous manner. Both digital and analog methods of storage have advantages and disadvantages, so that the choice between them depends upon the requirements in particular applications, including how the stored image is to be utilized in the diagnosis. If quantitative information is required, or if the image must first be processed in some quantitatively precise manner, then digital storage is probably most satisfactory. On the other hand, if the diagnosis is to be based on a visual inspection of the image, with secondary significance attached to precise quantification, then analog storage may be most satisfactory. The characteristics of some analog storage media are summarized. (C.H.)

50963 (CONF-691212–, pp 453-62) DESIGN OF NEW RADIOPHARMACEUTICALS. Wagner, Henry N. Jr. (Johns Hopkins Medical Institutions, Baltimore, Md.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

The finding that radioactive iodine accumulated in the thyroid led to its widespread use in medical diagnosis. Suppression of thyroid function by large doses of radioiodine was a milestone in medical science, and to date more than 200,000 patients with hyperthyroidism have been treated with radioiodine in the United States alone. The success of ^{131}I led to the search for other agents that would localize specifically in abnormalities, aid in their detection, and make possible improved therapy. A common factor that can be seen in subsequently developed radiopharmaceuticals is that they measure body functions. The abnormal areas are detected by instruments, such as scanners and cameras, because of the absence of normal function in specific regions. For example, brain tumors are detected by the absence of the normal blood–brain barrier; liver lesions are detected as focal decreases in the normal phagocytic function of the reticuloendothelial cells of the liver; and renal lesions are detected by a loss of glomerular or tubular function of the kidneys. The use of radioactive tracers in medical diagnosis can be thought of as an extension of the medical history and physical examination, i.e., the tracers permit the physician to obtain information about body functions and thereby assist in the solution of the patient's problems. Steps in the design of a radiopharmaceutical are (1) Selection of the physiologic process that is to be measured. (2) Establishment of the time course or temporal characteristics of the function being measured. (3) Establishment of the degree of spatial resolution needed to solve the problem. For example, will it be adequate to compare one kidney with another or will it be necessary to compare an area 1 cm^2 in size with its surrounding tissue? (4) Selection of the optimum radionuclide in light of the time course of the tracer, the required spatial resolution and the biologic behavior of the radiochemical. (5) Elimination of agents whose type of decay is unsuitable for the radiation-detection system to be used or whose production costs are too high. (auth)

50964 (CONF-691212–, pp 463-72) SURVEY OF THE DIAGNOSTIC USE OF RADIONUCLIDES IN HUMANS. Bauman, Roger A.; Williams, Kenneth D. (Bureau of Radiological Health, Winchester, Mass. [Northeastern Radiological Health Lab.]); Ruether, Fred G. (Bureau of Radiological Health, Rockwell, Md.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

In 1966 the Bureau of Radiological Health awarded a contract to the Stanford Research Institute to conduct a survey of the medical use of radioactive materials in the United States. This survey indicated that some 1,124,000 in vitro studies were performed and that 1,575,000 administrations were given to patients for in vivo function studies, scanning studies, and radiopharmaceutical therapy

in the calendar year 1966. Thyroid-uptake and blood-volume determination constituted the majority of the function studies. Thyroid, brain, and liver scans constituted the majority of the scan procedures. The results of this study indicated an apparent increase in the use of ^{57}Co over ^{58}Co for vitamin B_{12} absorption tests, a greater use of ^{99m}Tc for brain scans, and an increase of ^{197}Hg over ^{203}Hg for renal scans. (auth)

50965 (CONF-691212-, pp 491-507) FUTURE OF RADIOISOTOPES IN MEDICINE: BENEFITS VS. RISKS. Saenger, Eugene L.; Stumpe, William (Cincinnati Univ., Ohio. Medical Center).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8-11, 1969.

The future of nuclear medicine depends not only on continued scientific discoveries, leading to new techniques of diagnosis and treatment, but also on the evaluation of the benefits vs. the risks. Since radiation risks are related to radiation dose, the concept is supported that the lowest practical amount of radiation should be used in nuclear medicine techniques. However, the dose must be high enough to provide sufficient information to make an adequate diagnosis, otherwise it is not effective. In assessing the effectiveness of nuclear medicine, its results must be compared with other clinical and laboratory techniques and evaluation must be made of whether the test is essential, only useful, or misleading in the final diagnosis. For certain diagnoses, there is excellent correlation between a nuclear medicine technique and nonnuclear techniques. The evaluation of radiation risks also requires comparison with other risks since radiation is not the only medical agent capable of producing damage. For example, a recent study of women taking oral contraceptives has shown a 4.4-fold increase in thromboembolism. If radiation produced a comparable increase in deleterious effects, there would be a national outcry. At present there are no satisfactory methods for evaluating the effects of very low doses of radiation. Perhaps in the future it may be possible to use cytogenetic methods in association with epidemiological studies to determine whether relations exist between these low levels and certain diseases. If such associations are demonstrated in human beings, the radiation levels should be decreased; until then the present levels can be regarded as safe. Nuclear medicine is an important tool, and all of us dedicated to the future development of nuclear medicine must participate in the evaluation of risks vs. benefits. Only in this way will a proper perspective of risks and benefits develop and the health of our citizens be enhanced by our efforts. (auth)

50966 (COO-1422-79) DETERMINATION OF VERTEBRAL BONE MINERAL IN VIVO. Ort, M. G.; Cameron, J. R. (Wisconsin Univ., Madison. Dept. of Radiology). [1970]. Contract AT(11-1)-1422. 19p. Dep. CFSTI.

A method is described for the measurement of the bone mineral content of the lumbar spinal vertebrae of man. Gadolinium-153, with photon energies of approximately 43 and 100 keV, was used as a dichromatic γ source that was mounted on top of a standard x-ray tube placed below a table used for routine radiography. A scintillation detector with collimator and image intensifier was located above the table, on which the patient was carefully positioned. The assembly may be moved vertically or horizontally. Proper setting and alignment of the source and collimator were essential. A dual channel analyzer was used to separate the two photoelectric peaks from the ^{153}Gd source. The number of counts in each channel was counted for a fixed time at each measuring point and the data recorded for calculations of bone mineral content based on γ absorption coefficients. (C.H.)

50967 (COO-1653-87(Draft)) RADIOISOTOPIC ASSESSMENT OF CEREBRAL EDEMA. Adatepe, M. H.; Studer, R.; Perez, C.; Potchen, E. J. (Washington Univ., St. Louis, Mo. Edward Mallinckrodt Inst. of Radiology). [1969]. Contract AT(11-1)-1653. 9p. Dep. CFSTI.

Water edema was induced in rats by intraperitoneal injection of sterile pyrogen-free water and tin edema was induced by intraperitoneal injection of a solution of triethylene-tin bromide. The brain RBC space was determined using ^{59}Fe, the antipyrene space using ^{131}I, the albumin space using ^{125}I, and the technetium space using ^{99m}Tc. Water induced brain swelling was characterized by a marked decrease in brain RBC mass and albumin space with a slight increase in the brain antipyrene space and water content. The albumin space in tin induced brain edema was strikingly different from that seen in water intoxication consistent with the electron microscopic data suggesting an endothelial defect in tin edema. Observations suggest that it may be possible to clinically recognize and differentiate more subtle forms of brain swelling than is now possible with conventional brain scanning. (H.L.W.)

50968 (NYO-3468-18) TUMOR THERAPY WITH RADIOLABELED HETEROLOGOUS ANTIBODY. 6-Year Summary Report, October 15, 1964-October 14, 1970. Reif, Arnold E. (Tufts Univ., Boston, Mass. School of Medicine. Boston City Hospital, Mass.). 15 Jul 1970. Contract AT(30-1)-3468. 22p. Dep. CFSTI.

Data are summarized from a study on the detection and therapy of neoplasms following the in vivo localization of specific radioisotope-labeled antibodies in the lesions. Immunochemical procedures for the purification of the relevant antigens, the preparation of antibodies to these antigens, the purification of these antibodies, the labeling of the purified antibodies, and the testing of the labeled antibodies in paired-label experiments in animal model systems are described. Results using purified antibody labeled with 1 to 2 mc ^{131}I for scanning for the localization of tumors in man are reported. It is pointed out that tumor-specific antigens have been obtained from human hepatomas, teratoblastomas, sarcomas, melanomas, lymphomas, neuroblastomas, carcinomas of the colon and rectum, and to a lesser extent all neoplasms of the gastrointestinal tract. The outlook for therapy using high specific activity radioisotope-labeled specific tumor antibodies is discussed. (C.H.)

50969 ABDOMINAL MASS OF UNCERTAIN NATURE. Dogliotti, G. C. (Univ., Turin). Minerva Med.; 60: 3731-43(3 Oct 1969). (In Italian).

The steps in the clinical diagnosis of the nature of an abdominal mass associated with hypertension in a woman 29 years of age are summarized. The radiological reports locating the mass are given. The presence of a degree IV hypertensive retinopathy was detected. The clinical observations agreed with the symptoms reported in the literature for feocromocitoma. Surgical removal of the mass and its anatomopathological examination confirmed this diagnosis. The recovery of the patient was rapid with a sharp reduction of the disturbances connected with hypertension. The pressure was stabilized at a value of 160/90. Without the surgery the prognosis for the patient would have been very poor. (J.S.R.)

50970 EARLY FORM OF THE HOROMONE PHASE IN THE RADIOIODINE TEST. Boerner, W.; Moll, E.; Naumann, P.; Rauh, E.; Sinagowitz, E. (Medizinische Univ., Wuerzburg, Ger.). Klin. Wochensch.; 48: 357-62(15 Mar 1970). (In German).

The 2 hr-conversion ratio (protein bound radioiodine/total radioiodine in the serum 2 hr p.c.) is a useful parameter in the diagnosis of thyroid function. By determination in the course of the radioiodine-test with ^{131}I (48 hr) in 236 patients, the 2 hr-conversion ratio shows its high diagnostic value. By the 2 hr-conversion ratio we can differ between iodine deficiency and hyperthyroidism. Especially in patients with a reduced iodine-pool, i.e. after stromectomy, the 2 hr-conversion ratio is a more reliable parameter for thyroid function than the ^{131}I-radioiodine-test. The 2 hr-conversion ratio can complete the ^{131}I-test. The real value however has this parameter as part of an early thyroid function study with ^{132}I. (auth)

50971 KIDNEY SCINTIGRAPHY AND ITS DIAGNOSTIC EVALUATION FOR CLINICS. Schmidt, K. J. (Univ., Mainz). Klin. Wochensch.; 48: 389-94(1 Apr 1970). (In German).

Six hundred kidney scans carried out using ^{99m}Te-Fe(II) complex were evaluated in comparison to well-known radiological methods with reference to different renal diseases. From this, certain diagnostic criteria were derived. Especially the introduction of the quantitative comparison of both kidneys seems to be of great value for the diagnosis of hypertension. Of the well-known indications, scintigraphy of the kidneys seems to be especially suited for the detection of tuberculosis of this organ in an early stage and as a control method. Compared with the radiomercury compounds, the ^{99m}Te-Fe(II)-complex is superior both as to the statistical validity of the scintigrams and the radiation burden, so that this diagnostic method can also be applied in pediatrics. (auth)

50972 SURGICAL TREATMENT OF CHRONIC PANCREATITIS. Biancalana, L. (Univ., Turin). Minerva Med.; 60: 3779-93(6 Oct 1969). (In Italian).

Chronic pancreatitis shows such a varying and confusing symptomatology and is usually associated with so many primary and secondary diseases that it is often difficult to make a clear differential diagnosis. For this reason radiography is of the greatest importance in the treatment of this disease. It shows evidence of pancreatic concretions or calcification. Radiography of the stomach or duodenum may reveal deformations caused by cephalic prostatitis and the bile duct may show associated cholelithiasis. Radiography after a $BaSO_4$ contrast meal may indicate cysts or pseudocysts which can occur in any part of the pancreas. It was statistically established that 50% of sufferers of chronic pancreatitis have gallstones that are also visible by radiography. In any case where an operation is indicated, radiography of the pancreas and the surrounding area is essential to obtain a clear

picture of existing obstructions of ducts, the existence of cysts or concretizations, and also for the circumscription of the field of operation. Resection and anastomosis of the pancreatic ducts with the digestive tube were fairly successful. Total removal of the pancreas is a rather drastic procedure that should be avoided, if possible, not only because of the danger of subsequent diabetes but also because of the difficulty of providing essential exocrines. Therefore, at least part of the pancreas should be preserved. In the very difficult decision of which part of the pancreas must be removed and which should be retained, radiography of the pancreas offers the surgeon valuable guidelines. (F.J.W.)

50973 RADIOISOTOPE CISTERNOGRAPHY IN THE INFANT. Oberson, R. (Univ., Lausanne, Switzerland). Schweiz. Med. Wochensch.; 100: 867-74(16 May 1970). (In French).

Gamma-cisternography is an essential complementary examination in hydrocephalus. Its normal characteristics in children are rapid movement and absorption of the contaminated cerebrospinal fluid (CSF). Various criteria of normality exist. These are defined, and 34 pathological results are discussed. Data obtained from posttraumatic, postmeningitic or posthemorrhagic hydrocephalic patients could be divided into 6 groups of pictures. Some provisional conclusions are: In the case of diffusely reduced leptomeningeal pericerebral permeability or local circulatory impairment at important crossroads such as incisural notch or optochiasmatic cistern, either constant or transitory ventricular contamination may be observed. This apparently reversed flow of CSF could be accounted for by an increased or newly developed absorptive function of the ependyme, and this phenomenon constitutes the main indication for surgical treatment of hydrocephalus. If leptomeningeal permeability is only slightly and/or diffusely impaired, the bulk flow of CSF, i.e. absorption of some of its constituents, appears to be slowed. In this situation the patient should be followed up monthly, in order not to miss the opportunity of surgical correction. Absence of any apparent bulk flow would indicate an obstruction of the fourth ventricle foramina. Gamma-cisternography is also indicated in cases where CSF leakage is suspected. Here the examination precisely locates the fistula (direct proof of which is given by the picture on the scan) or shows contamination of the adjacent tissues and fluids (indirect proof of fistula). (auth)

50974 NEW RADIOLOGICAL TECHNIQUE IN RENAL STONE SURGERY. Leusch, Gerhard (Technische Hochschule, Munich). Urologe; 9: 182-8(Jul 1970). (In German).

A new radiological technique during surgery for kidney stones is described. The exposure technique with the apparatus "Status-X" fulfills all requirements, namely: All disturbing layers in the surroundings are eliminated; a second plane can be visualized in the same picture and very small calculi can be visualized. The theoretical background of this technique is described. Problems concerning asepsis were solved. An exposure technique of the renal poles using a special holder is described. Case reports are presented illustrating the principle and practical application. Further testing concerning the limitations of this technique is indicated. This would include technical improvements so that the apparatus may have more practical use in the operating room. (auth)

50975 WHOLE BODY COUNTING OF VITAMIN B_{12} ^{58}Co ABSORPTION SUPPLEMENTED BY PROFILE SCANNING. Finlayson, N. D. C.; Simpson, J. D.; Shearman, D. J. C. (Royal Infirmary, Edinburgh). Scand. J. Gastroenterol.; 5: 261-4(1970).

The profile scan patterns in the week following a test dose of ^{58}Co-cyanocobalamin are described in 24 subjects with normal and abnormal absorption of this substance. In nearly all cases a profile scan on the seventh day detected the presence of unabsorbed radioactivity in the bowel. This technique may be a useful adjunct in measuring vitamin B_{12} absorption by whole-body counting. (auth)

50976 SOLID-PHASE RADIOIMMUNOASSAY OF INSULIN. Ceska, M.; Grossmueller, F.; Lundkvist, U. (Pharmacia Aktiebolaget, Uppsala). Acta Endocrinol.; 64: 111-25(1970).

A solid-phase radioimmunoassay of insulin was developed using the plastic tube technique in which the inner walls of the tubes were coated with insulin antibodies. The binding of ^{125}I-insulin to the adsorbed antibody was shown to be quantitatively inhibited with the non-radioactive insulin present in the samples tested. The optimal conditions were determined for labelling of small amounts (3 μg) of insulin with radioactive iodine, coating of plastic tubes with insulin antisera and γ-globulin fractions, the stability of coated tubes with insulin antibodies, and radioimmunoassay of insulin. The reproducibility of the coated test tube technique for insulin determination was adequate from a clinical point of view and the ease with which this test was performed was advantageous from a practical point of view. (auth) (Sweden)

50977 DECLINE IN BLOOD ACTIVITY OF ^{125}I-FIBRINOGEN IN VENOUS THROMBOSIS. Jeyasingh, K.; Maurer, B.; Rosengarten, D. S.; Verma, T. R. (Hammersmith Hospital, London). Lancet; 2: 294-6(8 Aug 1970).

The rate of fall of radioactivity in the blood of patients who have been given ^{125}I-fibrinogen is increased when a venous thrombus forms. This increase occurs at a variable time before abnormal leg-counts indicate venous thrombosis. (auth) (UK)

50978 RADIOIMMUNOASSAY FOR URINARY ALBUMIN USING A SINGLE ANTIBODY. Miles, D. W.; Mogensen, C. E.; Gundersen, H. J. G. (Kommunehospitalet, Aarhus, Denmark). Scand. J. Clin. Lab. Invest. 26: 5-11(Aug 1970).

A simple and rapid single antibody radioimmunoassay for the accurate determination of urinary albumin in the normal range of concentrations is described. Microfiltration is used for the separation of free and antibody-bound radioalbumin. The specificity and reliability of the immunoassay is investigated in experiments on dilution, recovery, and following the addition of other proteins. The influence of time and temperature is studied. The range of 24-hour excretion of urinary albumin in 6 normal male subjects was 8.6 to 12.6 mg. (auth)

50979 REGULARIZATION UNFOLDING IN LOW γ-ACTIVITY MEASUREMENTS. I. EVALUATION OF ONE-DIMENSIONAL SCANNING. Clemente, G. F.; Marinelli, L. D.; Abu-Shumays, I. K. (Argonne National Lab., Ill.). Int. J. Appl. Radiat. Isotop.; 21: 307-18(Jan 1970).

The evaluation and use of a time-of-flight γ-ray camera, capable of measuring low-level activity distributions in vivo, requires the assessment of the relationship between distributions of the activity in vivo and of the corresponding scintillations in the camera. This relationship is described by a Fredholm equation of the first kind, a numerical solution of which—by the regularization unfolding method—is outlined. A preliminary study of the influence that various experimental parameters exert on the accuracy of this numerical solution and suggestions how best to choose these parameters whenever possible are given. The treatment is restricted to one dimension. Experimentally a line source distribution was simulated by a suitably shaped filiform source and the preliminary activity measurements were carried out by means of a collimated 3 × 3 in. NaI crystal displaced parallel to the plane of the source. (auth) (UK)

50980 QUANTITATIVE ANALYSIS OF RENOGRAMS USING THE GAMMA CAMERA. Holroyd, A. M.; Chisholm, G. D.; Glass, H. I. (Royal Postgraduate Medical School, London. Hammersmith Hospital, London). Phys. Med. Biol.; 15: 483-92(Jul 1970).

A method of analysis is described that uses gamma camera data previously stored on analogue magnetic tape to obtain quantitative information on renal function. The effective renal plasma flow and the input and output rate of hippuran for each kidney are calculated. Information on the intra renal transport of hippuran permits an estimate of tubular transit time. Examples of the practical application of the analysis are presented. (auth) (UK)

50981 GEOMETRICAL FACTORS IN PARTIAL BODY IN VIVO ACTIVATION ANALYSIS USING EPITHERMAL AND FAST NEUTRONS. Boddy, K.; East, B. W.; Robertson, I. (Scottish Research Reactor Center, East Kilbride, Scotland). Int. J. Appl. Radiat. Isotop.; 21: 500-3(Aug 1970).

It is usual practice in activation analysis to use standard comparators that are essentially identical in size and form to the sample and which are irradiated and monitored under identical conditions. This is difficult in in vivo analysis since organ size and depth and other factors vary among individuals. Comparison with phantoms needs to be justified by demonstrating that neutron activation will be sufficiently uniform for the expected range of biological variation and that monitoring equipment has corresponding geometrical independence. These factors are discussed for the measurement of intrathyroidal iodine by in vivo activation analysis; their implication in measurement of calcium in bone sections is also considered. (UK)

50982 BRAIN SCANNING USING ^{113m}In. Chang, Ko Chang; Lee, Jang Kyu (Radiological Research Inst., Seoul). J. Nucl. Sci. (Seoul); 10: No. 1, Pt. 2, 91-6(Jun 1970). (In Korean).

Brain scanning using ^{113m}In was done on 18 patients with clinically suspected or pathologically diagnosed brain tumors, including one brain abscess and one brain hematoma. Five normal cases and five patients with neuropsychiatric disorders were selected as the controls. The scanning findings of five normals and five patients with neuropsychiatric disorders showed no abnormalities or were compatible with the clinical states. Of the 18 patients with brain tumors, 14 were positive (78%), two equivocal and two negative.

Since 24 of all 28 examinees showed positive scans (86%), the diagnostic accuracy of brain scanning with ^{113m}In should be carefully appraised. (auth)

50983 DETERMINATION OF THE RADIATION DOSE TO THE THYROID GLAND AND ORGANISM IN DIAGNOSTIC USE OF RADIOIODINE. Levin, V. A. Med. Radiol.; 15: No. 6, 62-7(Jun 1970). (In Russian).

Thirty-two persons with euthyroid hormonal state, 41 patients with mild thyrotoxicosis, 14 patients with thyrotoxicosis of moderate severity, and 6 patients with hypothyroidism were investigated using ^{131}I. Also determined were the effective periods of radioiodine semiexcretion from the thyroid gland and the patient's body that were used for evaluation of the value of radiation loading. According to the data derived the mean absorbed dose in the thyroid gland in administration of 50 μC of radioiodine comprised 87 rad for patients with euthyroid hormonal state, 124 rad for patients with mild thyrotoxicosis, 134 rad for patients with thyrotoxicosis of moderate severity and 7 rad for persons with hypofunction of the thyroid gland. In radiodiagnostic investigation of the thyroid gland the integral absorbed dose did not exceed $8 \cdot 10^3$ r/rad. (auth)

50984 PREDICTION OF MYOCARDIAL INFARCTION BY HEMODYNAMIC EVALUATION USING ^{131}I. Sevelius, Gunnar. Isotop. Radiat. Technol.; 8: 111-13(Fall 1970).

A test was developed for predicting heart attacks based on the rate at which intravenously injected ^{131}I passes through the heart. Tests on 128 patients indicated that the accuracy of the test is 61% for a 6-month period, with only 9% false positive predictions. (auth)

50985 DIFFERENTIAL DIAGNOSIS OF CIRCULATORY DISTURBANCES WITH PULMONARY SCINTIGRAPHY FOR DETERMINATION OF PULMONARY EMBOLISM. Fridrich, R.; Hartweg, H.; Locher, J. (Univ., Basel). Fortschr. Geb. Roentgenstr. Nuklearmed.; 113: 219-31(Aug 1970). (In German).

Lung scanning is recognized as a valuable method for the demonstration of intrapulmonary bloodflow. Perfusion abnormalities in the pulmonary circulation produce defects in the scan. The scan alone, however, does not provide any evidence regarding the cause of the abnormal perfusion. Aetiological causes must therefore be sought following the scintigraphic demonstration of a perfusion defect; for this, a chest film is carried out. This is not always sufficient to differentiate an obstruction in the pulmonary circulation from reflex narrowing of the lung capillaries due to a ventilation defect, particularly in the presence of pre-existing cardio-pulmonary disease. Combined pulmonary scanning, on the other hand, makes it possible to determine the perfusion ventilation dependence in any given lung segment. It is therefore possible to demonstrate both perfusion and ventilation abnormalities. A perfusion abnormality, which is not associated with diminished pulmonary ventilation, must be due to obstruction in the pulmonary artery. On the other hand, a perfusion abnormality associated with abnormal distribution of the inhaled substance is due to a ventilation defect. Peripheral O_2 unsaturation in the pulmonary capillaries causes increased vascular resistence in the affected lung segment by means of the so-called Euler-Liljestrand-Rossier reflex and thus leads to a perfusion abnormality. Similarly, a pulmonary infarct resulting from an embolus that may be diagnosed on a chest radiograph by its typical appearances, leads to a simultaneous perfusion-ventilation defect on the combined lung scan. In general, we limit ourselves to performing a perfusion scan and a chest radiograph in patients in whom a diagnosis of a pulmonary embolus would result only in the institution of anticoagulant therapy. In patients in whom anticoagulant treatment is regarded as dangerous, if treatment with fibrinolysin appears indicated or where ligature of the inferior vena cava has to be considered, perfusion-inhalation scans are carried out as a combined examination. If a large, solitary defect is found and the possibility of an embolectomy is considered, pulmonary angiography is performed in addition, in order to achieve accurate localization in the pulmonary artery. (auth)

50986 POSITIVE SCINTIGRAPHIC REPRESENTATION IN FIBROUS DYSPLASIA OF THE FRONTAL SKULL BONE. Koelling, K. (Staedtische Auguste-Viktoria-Krankenhauses, Berlin). Fortschr. Geb. Roentgenstr. Nuklearmed.; 113: 216-18(Aug 1970). (In German).

X-radiography is an effective method in the evaluation of positive brain scans with ^{99}Tc. It is used to exclude the following bone abnormalities with increased vascularity: fibrous dysplasia, hemangiomas, osteitis deformans, and other forms of osteitis. (auth)

50987 ROLE OF SEQUENCE SCINTIGRAPHY AND ANGIOGRAPHY IN THE DIAGNOSIS OF REJECTION CRISIS FOLLOWING EXPERIMENTAL RENAL TRANSPLANTS. Mueller-Beissenhirtz, P.; Ziegler, M.; zum Winkel, K.; Beduhn, D.; Encke, A.; Poeplau, F.; Ruland, S. (Univ., Heidelberg). Fortschr. Geb. Roentgenstr. Nuklearmed.; 113: 148-57(Aug 1970). (In German).

Ten homologous renal transplants in dogs are described in which the course of rejection was observed with an Anger scintillation camera and by means of serial angiography. Serial observations by means of scanning with ^{131}I are a useful procedure in the early diagnosis of rejection. It can be carried out as often as one wishes. It is superior to angiography in the early recognition of rejection. Angiography, on the other hand, is the only method that can give a definite diagnosis regarding the blood supply and morphology of the transplant in doubtful cases. (TSS)

50988 SCINTIGRAPHIC FINDINGS AFTER CEREBRAL STROKE. Roesler, H.; Huber, P.; Hesse, M. (Univ., Bern). Schweiz. Med. Wochensch.; 100: 1401-10(15 Aug 1970). (In German).

In 83 brain scans for cerebrovascular lesions, using ^{99m}Tc-pertechnetate, only 45% gave a positive delineation of an infraction. Best results were obtained during the 3rd week after insult with 80% positive findings. This brain scan, typically performed later than 30 min after intravenous injection of the radioactive material was completed by serial scintigraphy and vascular scintigraphy. Step I, a fast series of camera scintiphotos, exposed for 4 sec each immediately after injection, visualizes the passage of a radioactive bolus through brain structures. Differentiation of an arterial, a parenchymatous, and a venous phase is possible by means of this radioangiography. Step II is a camera scintiphoto performed 3 min after technetium administration, which demonstrated different blood volumes in the skull. In 72 patients, selected for clinical evidence of cerebrovascular disease only, this serial cerebral scintigraphy never produced a normal scan, although 18 examinations were performed within the first 6 days after insult, and 22 after 2 months and later. In all there were 2.8 deviations from the normal pattern, and even 3.9 during the third week. These pathological symptoms were classified into 4 categories: regionally increased contrast in step II and step III positive in 37 examinations out of 83, occlusion and defect of a midbrain artery, with 60 observations the symptom most often seen, and asynchronization of the parenchymatous perfusion. The first and third were often seen in combination during the second and third week after an insult, but the second and third only exceptionally. However, the second and third predominated over early and more longstanding lesions. This complex examination provides additional criteria for the understanding of cerebrovascular insult as a disease which follows its own, time-bound, natural laws. Follow-up examinations and additional radioangiography in profile position provided additional information, especially regarding causality, and are never harmful for the patient. Serial scintigraphic examinations were compared with arteriographic findings in 29 cases. We found a good correlation in coarse defects of arterial supply, but poor agreement in visualization of parenchymatous perfusion. Our findings are to some extent comparable to those obtained by regional blood flow measurements using radioactive diffusible gases. (auth)

50989 SCINTIGRAPHIC FINDINGS IN CEREBRAL STROKES. Roesler, H.; Huber, P.; Hesse, M. (Univ., Bern). Schweiz. Med. Wochensch.; 100: 1446-54(22 Aug 1970). (In German).

Daily detailed observation of sequelae after cerebral stroke can be performed by the ^{99}Tc method without risk to the patient, if a scintillation camera is available as well as a well-trained team of technicians. In many cases, angiographic examinations with contrast media are necessary to confirm and to complete scintigraphic findings. The two procedures, as well as the clinical picture are necessary to arrive at a proper evaluation. (H.B.G.)

50990 EXPERIMENTAL ISOTOPE RENOGRAPHY AS A MEANS OF LOCALIZING URETERIC OBSTRUCTION. Lindgren, Ilmari; Maekelae, Pekka (Univ. of Turku, Finland). Acta Radiol., Diagn.; 10: 332-6(1970).

Experiments in isotope renography are performed in dogs whose ureters were closed at various levels for different lengths of time. It appears possible to determine the level of ureteric obstruction clinically from renograms obtained in this manner. (auth) (SW)

50991 RADIOLOGIC DIAGNOSIS OF SPLENIC METASTASIS. Gould, Howard R.; Clemett, Arthur R.; Rossi, Plinio (St. Vincent's Hospital and Medical Center, New York). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 109: 755-60(Aug 1970).

Three examples of the radiologic diagnosis of metastatic splenic tumor are reported. In two cases of metastatic melanoma, the history, concurrent pulmonary metastases and plain film roentgen

demonstration of the irregular nature of the splenic enlargement suggested the correct diagnosis. Technetium-99m sulfur colloid scans readily confirmed the diagnosis in each instance. The demonstration of discrete intrasplenic tumor masses by scanning aided in the diagnosis of disseminated reticulum cell sarcoma in a third case. Selective angiography complements the scan findings and may provide the definitive diagnosis when splenomegaly is the only clinical abnormality. (auth)

50992 FALSE POSITIVE BRAIN SCAN ASSOCIATED WITH FEBRILE CONVULSIONS. Nusynowitz, M. L.; Clark, R. W. (William Beaumont General Hospital, El Paso, Tex.). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 110: 71-3(Sep 1970).

A 14 month old girl had an abnormal brain scan associated with a febrile convulsion. This was considered a false positive result since further diagnostic evaluation and a brain scan performed 10 months later were normal. The brain scan abnormality was located in the region of the choroid plexus and, presumably, perchlorate pretreatment would have prevented the false positive result caused by accumulation of radiopertechnetate. (auth)

50993 CEREBROSPINAL FLUID (CSF) SCANNING: CISTERNOGRAPHY. James, A. Everette Jr.; DeLand, Frank H.; Hodges III, Fred J.; Wagner, Henry N. Jr. (Johns Hopkins Medical Institutions, Baltimore). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 110: 74-87(Sep 1970).

Cisternography is an excellent method to depict cerebrospinal fluid (CSF) compartments and to document CSF flow. Multiple views are necessary to accurately depict the anatomic configuration of a cerebrospinal fluid compartment, thus making its identification possible. The introduction of radioactive substances into the cerebrospinal fluid space is not a new procedure, but recent progress in imaging techniques and development of new radiopharmaceuticals has greatly increased the anatomic detail contained in the radioisotopic images and has allowed identification of specific CSF pathways and compartments. Cisternography may be used to determine the various forms of hydrocephalus; separate the types of porencephalic cysts and subarachnoid cysts; examine patients with pseudotumor cerebri and patients with meningocele; and to predict those patients who will benefit from CSF diversionary shunts. (auth)

50994 RADIONUCLIDES FOR MEDICAL APPLICATION. pp 381-500 of Handbook of Radioactive Nuclides. /Wang, Yen (ed.). Cleveland; Chemical Rubber Company (1969).

The applications of radioisotopes in clinical medicine are discussed. Papers included in the section discuss the following topics: measurement of cerebral blood flow; brain scanning; radioisotopes and the endocrine system; radioisotope diagnosis of cardiovascular disease; radioisotopes in respiratory-system studies; nuclear-medicine techniques in gastroenterologic diagnosis; the use of radioisotopes in the osseous and cartilaginous system; radioisotopes and the hematopoietic system; and radioisotope techniques applied to the genitourinary system. (E.R.B.)

50995 PITFALLS IN LIVER PHOTOSCANS. Covington, E. Eugene (Memorial Hospital, New York). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 109: 745-8(Aug 1970).

A study of 1,000 liver photoscans emphasized the reasons for false positive and false negative results. Common causes for false positive scans were: the gallbladder fossa; pressure defects of tumors; the fossa for the inferior vena cava; the porta hepatis; vertebral pressure defect in the midline; thinning out of the left lobe of the liver; pressure defect from the right kidney; and anatomic variations in size, shape, or position of the liver. Iodine-131-labeled rose bengal photoscans following false positives using colloids ^{198}Au or ^{99m}Te prevented many errors in diagnosis. False negative scans, or missed diagnoses, were proven at abdominal operation or autopsy on all metastases below 3 cm in diameter. Numerous nodules 4 cm in diameter, several 6 cm in diameter, and a few larger metastases were missed on the photoscan. The gamma camera or the rectilinear scanner, attached to a computer for quantitative recording of counts, and a larger dose of isotope for more rapid scans should improve present results. (auth)

50996 USE OF ^{11}C DIOXIDE FOR SKELETAL SCINTIGRAPHY. Galasko, C. S. B.; Coombs, R. R. H.; Clark, J. C. (Hammersmith Hospital, London). Brit. J. Radiol.; 43: 670-1 (Sep 1970).

It was shown that $^{11}CO_2$ is unsuitable for skeletal scintigraphy. The results suggest that it is evenly distributed through the body tissues and this is not surprising since carbon is an essential component of all biological material. The larger the bulk of tissue the greater the uptake and, therefore, it is suggested that its concentration in spontaneous osteosarcomata of dogs (Myers and Hunter, 1967; 1969) may have been due solely to the increased bulk of that limb. (auth) (UK)

50997 RADIOISOTOPE SCANNING OF THE PANCREAS. McGill, Douglas B.; Tauxe, W. Newlon. Med. Clin. N. Amer.; 54: 881-8(Jul 1970).

The agent used for scanning was selenomethionine, formed by replacing the sulfur atom of methionine with a γ-ray-emitting isotope of selenium (^{75}Se). Selenomethionine retains the biologic properties of methionine and can be incorporated into pancreatic-juice proteins. Approximately 7% of an intravenously injected dose is taken up by the pancreas very rapidly and can be detected as γ-emitting isotope over the pancreas in a very few minutes after injection. Numerous methods have been reported to increase the fractional uptake by the pancreas, but they have not been very successful; so the major technical modifications have been directed toward improvement of the electronic equipment. Because selenomethionine is taken up by the liver in addition to the pancreas, it has become routine to perform a liver scan simultaneously with another isotope taken up by the liver only, and to subtract its image from the one produced by selenomethionine. The subtraction can be either estimated visually or performed by electronic techniques. (auth)

Radiotherapy

Refer also to abstracts 50746, 50759, 50768, 50883, 50893, 50907–50909, 50912–50916, 50919, 51060, 51061, 51077, 51078, 51081, 51083, and 51087–51091.

50998 NOTES ON THE TELEGAMMATHERAPY OF OESOPHAGEAL CANCER. Granone, F. G.; Granone, G. (Univ., Turin). Minerva Radiol.; 14: 555-61(Dec 1969). (In Italian).

The particular anatomical and topographical features of the esophagus make accurate identification of the radiotherapeutical planes of its blastomas essential. The choice of the best manner of treatment may be based on the assessment of dose levels at critical points of the neighbouring organs. (auth)

50999 ENDOMETRIAL CARCINOMA IN PATIENTS WITH BILATERAL OOPHORECTOMY OR IRRADIATION CASTRATION. Hofmeister, F. J.; Vondrak, B. F. (Lutheran Hospital, Milwaukee). Amer. J. Obstet. Gynecol.; 107: 1099-1105(Aug 1970).

Seventeen instances of endometrial carcinoma when ovarian function has been eliminated by surgery or irradiation are presented as evidence of the hazards of the retained uterus. This increased hazard is due to complacency and inadequate methods of systematic, routine evaluation. The importance of dilatation and curettage, the value of the endometrial biopsy, and the necessity for a more aggressive attitude toward detecting endometrial lesions are stressed as being essential to a complete gynecologic examination. When bilateral oophorectomy is performed, total hysterectomy should always be performed. (auth)

51000 RADIOACTIVE COLLOIDAL SOLUTIONS FOR BETA-THERAPY. Mikheev, N. B.; Gracheva, M. N.; Seryi, S. V. Med. Radiol.; 15: No. 6, 74-8(Jun 1970). (In Russian).

Methods of obtaining radioactive colloidal solutions of yttrium silicate with ^{90}Y, zirconium phosphate with ^{32}P, and chromium phosphate with ^{32}P are described. Special attention is paid to the stability of colloidal solutions. Biological trials of the preparations were conducted that demonstrate that they fulfill requirements for intratissular betatherapy. (auth)

51001 62 CASES OF TELECOBALT TREATMENT OF OESOPHAGEAL CANCER. Faccini, M.; Gandini, S. (Istituti Clinici di Perfezionamento, Milan). Minerva Radiol.; 15: 116-28(Apr 1970). (In Italian).

Results are reported for 62 cases of cancer of the esophagus treated with ^{60}Co γ therapy. Statistical and technical data are presented and an account is given of intra- and post-treatment complications and survival frequencies. Reference is made to the immediate results and a comparison is drawn between palliative therapy, and survival. (auth)

51002 RADIATION DOSIMETRY DURING ENDOLYMPHATIC THERAPY WITH ^{131}I. Pfannenstiel, P.; Wetzig, E.; Kleine, N. (Medizinische Univ., Freiburg i. B.). Nucl.-Med.; 32: Suppl. 7, 439-48(1968). (In German).

From 5th Conference of the Society of Nuclear Medicine, Vienna, Austria. See CONF-670996.

In endolymphatic therapy with ^{131}I-labeled x-ray contrast media, the effective dose to lymph nodes (approximately 75% of the administered dose) can be determined from the duration of deposition and from the volume of the nodes. If 37 mCi are administered, the lymph nodes receive a dose of 139 krads; by transmission through

the thoracic duct, the lungs are exposed to 830 rads. Twenty patients, thus far treated, are too small in number to evaluate therapeutic significance of the method. To avoid radiation damage to the lungs, either the radioisotope dose must be reduced or the thoracic duct must be ligated. 48 references are given. (H.B.G.)

51003 GLUCOCORTICOID FUNCTION OF THE ADRENAL CORTEX IN RADIUM THERAPY OF CANCER OF THE UTERINE CERVIX. Abdullaeva, I. A. (Scientific-Research Inst. of Radiology and Oncology, Baku). Med. Radiol.; 15: No. 1, 19-23 (Jan 1970). (In Russian).

The glucocorticoid function of the adrenal cortex in 30 patients with second and third stage cancer of the adrenal cortex was studied by determining the diurnal urinary level of 17-oxycorticosteroids. The spontaneous diurnal excretion of free and total 17-oxycorticosteroids in patients was augmented in comparison with healthy persons. A loading of 40 IU of zinc-phosphate ACTH revealed a relative preservation of the reserves of the adrenal cortex. In patients with carcinoma of the uterine cervix undergoing radium γ therapy there was seen an intensification of the spontaneous excretion of 17-oxycorticosteroids at the middle of radium therapy and reversal to the initial level at the end. After ACTH loading there was noted a certain rise of the index of total 17-oxycorticosteroids at the end of radium therapy. (auth)

51004 ERRORS IN THE REPRODUCTION OF THE PROGRAM OF MOBILE TELEGAMMA-THERAPY. Belotserkovskii, S. E. Med. Radiol.; 15: No. 5, 31-5(May 1970). (In Russian).

The design features of two mobile ^{60}Co γ teletherapy units were evaluated for possible factors that would affect reproduction of the dose. The maximum error value was determined for the two units. (C.H.)

51005 THE CHOICE OF A PRINCIPAL SCHEME OF HIGHLY MOBILE GAMMA-THERAPEUTIC APPARATUS. Atovm'yan, A. E.; Gordon, V. I.; Davydova, I. A.; Litvan, A. B. (Moscow Scientific Research Inst. of Roentgen-Radiology). Med. Radiol.; 15: No. 5, 28-31(May 1970). (In Russian).

The quality of the radiation dose from a mobile ^{60}Co γ teletherapy unit was evaluated. A new method for mounting the radiation source is suggested for improvement of the dose distribution. (C.H.)

51006 AUTOMATIC SOURCE POSITIONING FOR CATHETRON TREATMENTS. Twiss, D. H.; Bradshaw, A. L. (Queen Elizabeth Hospital, Birmingham, Eng.). Brit. J. Radiol.; 43: 48-53 (Jan 1970).

An account is given of the requirements and design of an additional unit for the Cathetron which allows automatic source positioning during treatment. This unit has been constructed without any major modifications to the original machine and is in regular clinical use. By the use of two extra timers and source position sensors dose distributions very similar to those given by gynaecological radium applicators can be achieved. Various design features and interlocking systems are described, and two possible methods of timing the treatments are discussed. The unit described functions for one source drive, and the possibility of extending the automatic facility to all three drives or to further source positions is foreseen. (auth) (UK)

51007 PIGMENT TUMORS OF THE CONJUNCTIVA. CRITICAL REMARKS TO X-RAYING. Heydenreich, A. (Univ., Jena, Ger.). Acta Ophthalmol.; 48: 369-82(1970). (In German).

Naevus pigmentosus is the most frequent pigment tumor of the conjunctiva and is mainly seen in young people. As it often becomes malignant, its early removal is absolutely necessary. The malignant melanoma mainly occurs late in life. In spite of total extirpation or enucleation, and exenteratio orbitae and x-raying, death cannot always be prevented. The x-raying of epibulbar tumors is on account of its danger to the bulbus no longer an adequate method. In this connection serious injuries of the eye background are reported. (Denmark)

51008 INTERSTITIAL CURIE-THERAPY (GAMMA MED) OF DS-CARCINOSARCOMAS IN RATS AFTER RADIOSENSITIZATION USING BROMDEOXYURIDINE BROMDEOXYCYTIDINE, AND ANTIMETABOLITES (PRELIMINARY REPORT). Mundinger, F.; Jobski, Ch.; Vogt, P.; Fischer, H. U. (Univ., Freiburg i. B.). Atomkernenergie; 15: 157-61(1970).

Interstitial Curie therapy with the ^{192}Ir contact-irradiation apparatus Gamma-Med leads to a clinically verified improvement in the results of irradiation. In the experimental investigations on DS-carcinosarcoma of rats it is shown that the additional preliminary treatment over a period of several days with the radiosensitizers BUdR and bromodeoxycytidine with the combined antimetabolites methotrexate, 5-fluouracil and 6-azathymine increased the biological effect of the interstitial Curie-therapy. The number of the antimetabolites, the quantity of substance applied, and the frequency of the applications were varied in the screenings. The greatest number of cures was achieved using the simple combination of bromdeoxyuridine and methotrexate. In comparison combinations of bromdeoxycytidine with 5-fluoruracil had a very small effect on the tumor used in these series of tests; this finding contrasts sharply with the results reported in the literature. (auth)

51009 PHYSIOCO-THEORETICAL AND TECHNICAL BASES OF ^{192}Ir INTERSTITIAL RADIOTHERAPY. Sinistrero, G.; Benedetto, A. (Univ., Turin). Minerva Dermatol.; 42: 574-82(Dec 1967). (In Italian).

The physical characteristics of radioiridium are briefly examined and the different application techniques (threads, clips, plaster casts, Isofix) illustrated. Dosimetry is then considered, particular attention being paid to tomographic dosimetry. The usefulness of the "non-radioactive" preparation is then discussed and mention made of the considerable possibilities of radioprotection obtained by associating this with radioiridium. It is concluded that iridium is a very useful radioisotope for performing interstitial and plaster cast radiotherapy. (auth)

51010 USE OF RADIOACTIVE PHOSPHORUS TO TREAT BONE PAIN IN METASTATIC CARCINOMA OF THE PROSTATE. Morales, A.; Connolly, J. G.; Burr, R. C.; Bruce, A. W. (Queen's Univ., Kingston, Ont.). Can. Med. Ass. J.; 103: 372-3(Aug 1970).

Experiments and results in the use of ^{32}P for therapeutic purposes are described briefly. (F.S.A.)

Radiation Effects on Animals

Refer also to abstracts 50705, 50770, 50807, 50841, 50889, 50957, and 50959.

51011 INTERACTION OF LYMPHOCYTES AND A RADIO-RESISTANT CELL IN PPD-STIMULATED HUMAN LEUKOCYTE CULTURES. Schechter, Geraldine P.; McFarland, William (Veterans Administration Hospital, Washington, D. C.). J. Immunol.; 105: 661-9(Sep 1970).

A 5- to 7-day incubation of heavily irradiated (2000 R) human leukocytes yielded a macrophage-rich population which was capable of markedly increasing blastogenic reactivity to PPD (purified protein derivative) of lymphocytes from sensitive donors as measured by incorporation of tritiated thymidine. These radioresistant cells were also demonstrated in some donors to be capable of initiating the blastogenic response after being only briefly exposed to antigen. This activity was demonstrable only when these cells were intact, viable, in direct contact with the lymphocytes and pulsed with antigen sometime within the preceding 72 hr. This ability to initiate blastogenesis in lymphocytes was inhibited if macrophage exposure to antigen occurred at low temperature or in the presence of actinomycin D or cyanide. (auth)

51012 GENERATION TIME IS LENGTHENED IN PARAMECIUM AURELIA CULTIVATED UNDER RADIOPROTECTION. Tixador, R.; Planel, H.; Richoilley, G.; Tollon, J. M. (Faculte de Medecine, Toulouse). Compt. Rend. Soc. Biol.; 163: 1429-32(1969). (In French).

Previous studies have shown that Paramecium aurelia or P. caudatum cultivated under protection from natural radioactivity have a lower growth rate than cultures developed in natural conditions. New studies were made to determine the biological effects of the protection. The results of studies made on Paramecium aurelia showed that protection from natural radioactivity prolonged the cellular cycle. This effect is constant and immediate. The prolongation of the generation time is, in absolute value, essentially the same for organisms from cultures in the exponential phase or in the stationary phase of growth. In relative values, the effects of protection are more significant for paramecia from cultures in exponential phase; their generation time is shorter than for paramecia from cultures in static phase. The prolongation of the generation time shows that the population decrease observed previously under radioprotection comes, at least in part, from a slowing down of the multiplication capacity of the paramecia. (J.S.R.)

51013 X-RAY IRRADIATION OF THE INNER EAR OF THE GUINEA PIG. AN ELECTRON MICROSCOPIC STUDY OF THE DEGENERATING VESTIBULAR SENSORY CELL. Winther, F. Oe. (Oslo Univ.). Acta Oto-Laryngol.; 69: 307-19(1970).

The inner ear of the guinea pig was irradiated with single doses of 7000 R X-rays. An electron microscopic study of the vestibular part of the labyrinth was performed after 1½, 3, 4, and 6 hours.

Changes were noticed chiefly in the type II but also in some type I sensory cells. The first changes were observed in the nuclei and consisted of clumping of the chromatin and the interchromatinic granules and swelling of the nuclear envelope. Later the nuclei became pycnotic. In the cytoplasm the early changes were: an appearance of a large number of vacuoles with the surface studded with ribosomes, various mitochondrial alterations, a slight increase in the number of lysosome-like bodies in the apical portion of the cells, and an appearance of sequesters of small cytoplasmic areas delimited by one or more layers of membranes. Severely altered cells appeared shrunken. The elimination of the degenerating cells is supposed to occur in two ways. The apical portion is expelled into the endolymph while the perinuclear portion is phagocytized by the supporting cells. Except for phagocytized material, no changes were noticed in the supporting cells. (auth) (SW)

51014 DNA-SYNTHESIS AND MITOSIS-INDEX IN THE EMBRYONAL HEART-ANLAGE AFTER A SINGLE X-IRRADIATION ON THE RAT. Wegner, G. (Univ., Freiburg i. B.). Z. Gesam. Exp. Med.; 152: 236-43(1970). (In German).

The number of DNA-synthesizing cells (^{3}H-index) and the frequency of mitosis were determined autoradiographically in the normal unaltered embryonal development of the heart of rats as well as after 150 R irradiation at initiation of organogenesis. In the normal unaltered development of the heart, an increased number of DNA-synthesizing cells and mitotic figures during stages of higher growth activity were observed. After a single whole-body irradiation of the mother animal at 9th or 10th day of pregnancy, the ^{3}H-index of the embryonic heart anlage is decreased to values no longer measurable up to 15 hr postirradiation. Finally after 24 hr the normal values of the control were reached again and remained normal during all the next days. The frequency of mitosis was reduced up to 3 days postirradiation. This indicates a high radiation sensitivity of early embryonic heart anlages, which becomes evident, too, in a high index of pyknotic cells (30%). (auth)

51015 A COMPARISON OF RADIOINDUCED REPRODUCTIVE DEATH AND CHROMOSOME EXCHANGES IN CHINESE HAMSTER CELLS AT ROOM TEMPERATURE AND IN LIQUID NITROGEN. Fetner, Robert H. (Georgia Inst. of Tech., Atlanta). Int. J. Radiat. Biol.; 17: 467-78(1970).

Reproductive cell death and chromosome exchanges produced in cultured primary Chinese hamster cells after exposure to 250 kV x rays were studied with irradiation performed at room temperature and in liquid nitrogen. In the cell population irradiated are room temperature, the mean lethal dose was 179 rads, and there were 0.38 chromosome exchanges per cell. With irradiation in liquid nitrogen, the mean lethal dose was 977 rads, and there were 0.19 exchanges per cell. Thus, irradiation at the low temperature resulted in one-half as many chromosome exchanges per cell at the mean lethal dose. This suggests that chromosome exchanges are not a direct cause of radiation-induced cell reproductive death. At low temperatures, survival curves were exponential and the dose power for the production of chromosome exchanges per cell was less than one. The significance of these findings is discussed. (auth) (UK)

51016 RECOVERY OF CHINESE HAMSTER CELLS FROM ULTRA-VIOLET IRRADIATION DAMAGE. Humphrey, R. M.; Sedita, B. A.; Meyn, R. E. (Univ. of Texas, Houston). Int. J. Radiat. Biol.; 18: 61-9(1970).

The results of this investigation indicate that a Chinese hamster cell-line (CHO) is capable of recovery from u.v. irradiation. Another Chinese hamster cell-line (B-14FAF28), which was found to be more sensitive to U.V.L., is not capable of recovery. A comparison of cells in G_1 phase and S phase revealed that cells in S phase recover, whereas those in G_1 phase do not. It appears, therefore, that recovery between fractionated doses of U.V.L. is dependent on cell-line and cell-age, which suggests that the recovery process is genetically controlled and qualitatively and quantitatively different from recovery following ionizing radiation. (auth) (UK)

51017 SURVIVAL OF HeLa CELLS FROM 10 NANOSECOND PULSES OF ELECTRONS. Nias, A. H. W.; Swallow, A. J.; Keene, J. P.; Hodgson, B. W. (Christie Hospital, Manchester, Eng.). Int. J. Radiat. Biol.; 17: 595-8(1970).

Survival curves are reported for HeLa cells irradiated under aerated and hypoxic conditions with 10 MeV electrons from a linear accelerator. Each irradiation was delivered in a single 10 nanosecond pulse. The cells were irradiated in suspension and then plated for clonal growth. (auth) (UK)

51018 HYPOXIA IN RADIOBIOLOGY. Moore, J. L.; Smith, C. W. (Velindre Hospital, Cardiff, Wales). Brit. J. Radiol.; 43: 583-6(Aug 1970).

The subject is discussed under the following headings: flatness in glass and polystyrene petri dishes and the subsequent variation in height of medium, with its effect on oxygen diffusion and cell numbers; diffusion and respiration of oxygen dissolved in the medium, with reference to the effect of temperature, number of cells on a petri dish, and depth and movement of the medium; and radiation consumption of oxygen and its effect on survival curves, with reference to those of mammalian cells. (UK)

Invertebrates

Refer also to abstracts 50776, 50783–50789, 50808, 50837, 50839, 50840, and 50852.

51019 EFFECT OF PARTIAL OR WHOLE-BODY IRRADIATION OF PUPAL OR ADULT FEMALE HOUSE-FLIES ON OVARIAN MATURATION AND RETENTION OF PUPAL FAT BODY. Nelson, Dennis R.; Flint, Hollis M.; Adams, T. S. (Dept. of Agriculture, Fargo, N. Dak.). Int. J. Radiat. Biol.; 18: 71-9(1970).

Irradiation of late pupae or newly-emerged adults of Musca domestica L. with 1.8 to 2.25 kR of x-irradiation prevented ovarian development but had no effect on the disappearance of the pupal fat body; irradiation of 24-hour-old pupae with 1.5 kR caused 53 per cent mortality, stunted ovaries and retention of the pupal fat body by 69 per cent of the subsequent adults 96 hours after emergence. Shielding experiments showed that irradiation of the anterior one-third of the body of young pupae reduced emergence but had no effect on the ovaries or on the disappearance of the pupal fat body in the subsequent adults; irradiation of the posterior portion of the body stunted the ovaries and caused the retention of the pupal fat body in the subsequent adults. (auth) (UK)

51020 SUSCEPTIBILITY OF THE LONG HEADED FLOUR BEETLE, LAETHETICUS ORYZAE WATERH TO GAMMA RADIATION. Dayen, Abdul; Ahmed, Mainuddin (Atomic Energy Centre, Dacca, Pakistan). Nucl. Sci. Appl., Ser. A; 26-30(Apr 1969).

An investigation was carried out to examine the effects of γ radiation from a ^{60}Co source on the different developmental stages of long headed flour beetle, Laetheticus oryzae W. The insects were maintained on flour in the laboratory at normal temperature and relative humidity. A total kill of eggs and larvae was obtained by 6 kR, and of adults by 10 kR. A dose between 10 kR to 12 kR may be taken as the minimum effective dose for the control of Laetheticus oryzae. (auth)

51021 OBSERVATIONS ON THE BEHAVIOUR OF PARAMECIUM JENNINGSI UNDER THE INFLUENCE OF A SUBLETHAL DOSE OF X-RAYS. Komala, Zofia (Inst. of Systematic and Experimental Zoology, Krakow). Folia Biol. (Krakow); 18: 1-8 (1970).

Comparative studies on the influence of x radiation on Paramecium jenningsi and P. aurelia were carried out. Mass cultures were derived from single individuals for obtaining synchronized division. Groups of 72 individuals were x-irradiated and isolated into depression slides. The number of individuals in a clone was counted 24, 48, and 72 hrs after irradiation and the number of fissions the clones passed through was estimated. Irradiated and control clones were transferred to test tubes and cultured for two weeks to estimate the number of surviving clones. It was found that fission was delayed in both of the x-irradiated groups; the delay was considerably greater in P. jenningsi than in P. aurelia. Irradiation did not cause death of any of the P. aurelia specimens, while about 21% of the P. jenningsi died. The radiosensitivity of various species of Paramecium is discussed. (H.L.W.)

51022 RECOVERY OF SUPRALETHALLY X-IRRADIATED AND NITROGEN MUSTARD (HN2)-TREATED AMOEBAE. Daniels, Edward W.; Breyer, Evelyn P. (Argonne National Lab., Ill.). Int. J. Radiat. Biol.; 18: 179-87(1970).

Large multinucleated amoebae, Pelomyxa illinoisensis, irradiated with 30 kR of x-rays (a supralethal dose), died after 4 to 5 days without dividing. Amoebae treated with supralethal doses (0.1 or 0.2 mg/ml. for 1 hour) of nitrogen mustard (HN2; Mustine HCl; Mustargen HCl; $CH_3N(CH_2CH_2Cl)_2HCl$), died several days after treatment without cell division. When protoplasm from HN2-treated amoebae was injected by fusion into x-irradiated amoebae, the composite organisms reproduced and permanently recovered. Cytoplasm from HN2-treated donors also induced recovery. HN2-treated amoebae, unlike x-irradiated amoebae, did not recover after the injection of cytoplasm from non-treated, unirradiated amoebae. Supralethal doses of actinomycin D, puromycin, tetracycline, oxytetracycline, 2,4-dinitrophenol, sodium

fluoroacetate, or sodium fluoropyruvate prevented the donor protoplasm from restoring x-irradiated amoebae. The results were interpreted to indicate that polyribosomes and their larger subunits, from nontreated (or HN2-treated) donor amoebae, produced recovery of x-irradiated amoebae; nuclei from either untreated or x-irradiated amoebae, but not cytoplasm, produced recovery of HN2-treated amoebae. (auth) (UK)

Vertebrates

Refer also to abstracts 50674, 50678, 50679, 50706, 50708, 50713, 50718, 50719, 50721, 50730–50734, 50737, 50739, 50740, 50743, 50744, 50751–50753, 50755, 50769, 50773, 50775, 50777, 50779, 50782, 50790–50793, 50801, 50810, 50832, 50842, 50851, 50853, 50854, 50857, 50858, 50924, 50932, 50951, 50955, 50956, and 50958.

51023 (AAEC/LIB/Bib–243) BIBLIOGRAPHY ON THE REGENERATING LIVER IN THE RAT AND MOUSE, INCLUDING RADIATION EFFECTS ON, MORPHOLOGICAL, AND BIOCHEMICAL CHANGES IN THE REGENERATING LIVER CELLS. Newland, E. A.; Middleton, M. R. (comps.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1970. 48p. Dep. CFSTI (U. S. Sales Only).

Six hundred references covering the period during 1958 to 70 are presented. The references are listed chronologically by year and alphabetically by author within each year. Reference is also made to an abstract for each article. (auth) (Australia)

51024 (ACRH–1000–205) SOME STUDIES ON THE X-RAY EFFECTS ON RESTING HAIR CELL POPULATION. Griem, M. L.; Malkinson, F. D.; Marianovic, R.; Kessler, D. (Argonne Cancer Research Hospital, Chicago, Ill.). [1968]. 10p. (CONF-700610–9). Dep. CFSTI.

From 4th International Congress of Radiation Research, Evian, France.

The response of telogen, or resting hairs, of mice to ionizing radiation was investigated using 45 kV x rays. Several conclusions were drawn concerning this non-proliferating cell population. No recovery in the reduced uptake of tritiated serine was demonstrable in telogen hairs up to 12 days post-irradiation, indicating a lack of repair in the resting cell population. Data on survival of hair, post-irradiation, revealed significantly lowered radiosensitivity in telogen, as compared to anagen, or growing hair populations. Observations of the body coat made almost one year after irradiation in the telogen with 2000 to 2500 rads revealed persistently reduced hair lengths and slower hair regrowth after plucking. Percent tritiated thymidine mitosis curves showed no change in proliferative cell cycle times, but mitotic index determinations suggested permanent reductions in hair matrix cell populations. It was concluded that the observations may have important implications for radiation responses of non-proliferating cell populations in radiotherapeutic situations. (C.H.)

51025 (AD–698753) INTERLABORATORY COMPARISON OF MORTALITY IN SHEEP EXPOSED TO ^{60}Co GAMMA RADIATION. Mobley, Thomas S.; Still, Edward T.; Rush, William; Taylor, James F.; Persing, Ronald L. (Air Force Weapons Lab., Kirtland AFB, N. Mex.). Oct 1969. 40p. (AFWL–TR–69–48). CFSTI.

An attempt was made to resolve the differences in sheep 60 day median lethal dose (LD50 (60)) values between Air Force Weapons Laboratory (AFWL) and Naval Radiological Defense Laboratory (NRDL). Each laboratory purchased sheep from local suppliers. One-half the animals were air lifted to the recipient Laboratory in January 1968. The second half of the animal exchange was accomplished in June 1968. Each laboratory gave graded doses of ^{60}Co γ radiation on successive days to: animals held for six months (acclimatized) and animals held for one week (nonacclimatized). Median lethal dose values on NRDL sheep irradiated at AFWL increased from previous values. Median lethal dose values on AFWL sheep irradiated at NRDL likewise increased. The findings of the interlaboratory investigation confirmed the existence of factors (not presently understood) that resulted in higher LD50 (60) values than encountered at the home laboratories. A number of factors potentially responsible for the findings are discussed. (auth)

51026 (AD–703273) HEMATOPOIETIC RECOVERY IN IRRADIATED DOGS. Baum, S. J.; Wyant, D. E. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Feb 1970. 33p. (AFRRI–SR–70–2). CFSTI.

The objectives of this study were to measure hematological recovery responses in the sublethally irradiated dog exposed to 150 rads of x rays; and, furthermore, to compare these effects with those observed in animals irradiated with 150 rads of mixed gamma-neutron radiation. Finally, measurements of hematological recovery capabilities were to be obtained in previously irradiated dogs subjected to subsequent identical exposures after 3-month intervals. (auth) (USGRDR)

51027 (AD–704167) ANNUAL RESEARCH REPORT: JULY 1, 1968–JUNE 30, 1969. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). 57p. (AFRRI–ARR–3). CFSTI.

Contents include: Acute mortality response of larger mammals to ionizing radiation; Investigation of incapacitating doses of radiation in larger mammals; The effect of partial-body shielding; Acute mortality of mice and rats exposed to 14 MeV neutrons; Behavioral incapacitation studies; The behavioral performance of the unrestrained monkey following mixed gamma-neutron irradiation; Identification of prominent sites of radiation injury; Hemogram and bone marrow differential of the chinchilla; Effects of ionizing radiations on biosynthesis of complex proteins; Effect of mixed gamma-neutron radiations on plasma and urine amino acid levels in the rat; Effects of ionizing radiation on immune responses; Postirradiation gastrointestinal injury; and Radiation fields produced by the afrri-triga reactor. (USGRDR)

51028 (ANL–Trans–851) DATA CONCERNING THE BIOLOGICAL EFFECT OF THE MIXED NEUTRON RADIATION OF ATOMIC REACTORS. Sztanyik, Laszlo. Translated for Argonne National Lab., Ill., from Adatok az Atomreaktor Kevert Neutron-Gamma-Sugarzasanak Biologiai Hatasarol, Medicina Publishing House [Budapest], 1967. 21p. Dep. CFSTI.

The mortality of mice irradiated in an atomic reactor is higher than that of mice x-irradiated with the same absorbed dose. Particularly serious lesions are induced in the gastrointestinal tract that might lead to an early death of the animal even after small irradiation doses. The increased biological effectiveness of the mixed radiation might be attributed to its fast neutron component. Amidoethylisothiuronium (AET) to some extent reduces the mortality of mice irradiated in the reactor. However, it still remains to be elucidated whether there is a protection against neutrons really or only a protection against the role γ radiation plays in the observed effect. (auth)

51029 (ANL–Trans–852) DATA CONCERNING THE HUMORAL REGULATION OF BLOOD FORMATION IN IRRADIATED AND CONTROL ANIMALS. Feher, Imre; Gidali, Julia. Translated for Argonne National Lab., Ill., from pp 29–41 of National Frederick Joliot-Curie Research Institute for Radiation Biology and Radiation Medicine 10th Anniversary, Medicina Publishing House, Budapest, 1967. 20p. Dep. CFSTI.

Experiments on the effects of 150 and 600 R radiation doses on the number of granulocytes, lymphocytes, and thrombocytes showed an initial decrease followed by an increase in the number of cells in rabbits. In order to determine the presence of a Leukocytosis Induction Factor (LIF) in the serum of irradiated animals, rabbits were irradiated and bled, and their plasma was administered to recipient rabbits; the blood picture in the recipient rabbits was similar to that of the irradiated rabbits. Data indicated that the plasma of the irradiated animals contained a substance that stimulated hematopoiesis in the recipient animals. Other studies indicated that a second stimulating factor, the myelopoietic substance, was present in the serum. Although LIF was produced in animals exposed to lethal doses of radiation, the myelopoietic substance declined after small doses. (H.L.W.)

51030 (ANL–Trans–853) THE EFFECT OF X-RAY, ^{60}Co AND MIXED NEUTRON-GAMMA RADIATION ON THE INCORPORATION OF ^{59}Fe IN THE ERYTHROPOIETIC SYSTEM OF MICE. Sztanyik, Laszlo; Mandi, Erika. Translated for Argonne National Lab., Ill., from pp 42–55 of National Frederick Joliot-Curie Research Institute for Radiation Biology and Radiation Medicine 10th Anniversary, Medicina Publishing House, Budapest, 1967. 18p. Dep. CFSTI.

The results of iron metabolism experiments performed with ^{59}Fe on mice made it possible to derive certain quantitative relationships between the lethal and sublethal doses of radiation of different types and their effects on erythropoiesis. Data indicated that the 72-hour incorporation of intravenously administered ^{59}Fe was a suitable index for the characterization of the erythropoietic activity of irradiated mice. The ^{59}Fe absorption of hematopoietic tissues, storage organs, and other tissues was found to be a less reliable indication. The experiments confirmed the data in the literature indicating high radiation sensitivity of erythropoiesis in mice. The utilization of ^{59}Fe given 24 hrs after exposure was reduced by 50% by radiation doses as low as 80 rad x ray of ^{60}Co γ radiation, or 40 rad of mixed neutron-radiation. The mixed radiation of the reactor with its substantial fast neutron component inhibited the erythropoiesis of mice more than x rays or γ radiation. The relative biological effectiveness of the different types of radiation could not be clearly determined. The effectiveness of the neutron-γ radiation increased with time

between exposure and injection; this was attributed to the extensive depression of the regenerative processes by the neutrons. (H.L.W.)

51031 (CONF-691212–, pp 413-24) TUMORIGENIC EFFECTS OF SMALL AMOUNTS OF RADIATION. Mewissen, Dieudonne J. (Chicago Univ., Ill.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

This paper compares the late effects of single low-dose exposures to radiations of various linear energy transfers. A total of 8,229 mice was assigned to four groups: (1) nonirradiated control, (2) fast-neutron irradiated, (3) irradiated with ^{60}Co γ rays, and (4) treated with tritiated thymidine. The doses used were 9, 13, 18, 25, 36, 51, 71, 100, and 141 Rems for fast neutrons or ^{60}Co radiation (RBE of 1.8 for neutron/cobalt). Tritiated thymidine was injected at birth at the following dose levels: 0.3, 0.4, 0.6, 0.9, and 1.5 μCi/g. The following conclusions can be drawn from the preliminary results: (1) Although C57BL mice are classically considered to be tumor free, tumor incidence was greater than 50% during the animal's life; (2) radiation exposure caused a change in the tumor incidence pattern by possibly shortening the mean latent period for tumor development; and (3) there was a questionable inhibitory effect on tumor incidence or development after a single whole-body exposure to 9 rems of fast neutrons. (auth)

51032 INDUCTION OF POST-IRRADIATION CONDITIONED AVOIDANCE BEHAVIOR BY INTRAPERITONEAL INJECTION OF BRAIN TISSUES. LeVan, H.; Hebron, D. L.; Moos, W. S.; Mason, H. C. (Veterans Administration Hospital, Hines, Ill.). Experientia; 26: 648-9(15 Jun 1970).

Donor mice that were conditioned for saccharin preference were x irradiated at 400 R at a dose rate of 80 R/min. Within 30 min after actual or sham irradiation, all donor animals were sacrificed and solutions of their brain tissues were prepared. The solutions were then injected into the peritoneal cavity of recipient mice. During the taste preference test, the difference in average daily saccharin and water consumption was between 15 and 20 cm^3 in favor of the sweet solution. After the injection of brain tissues, the trend was still clearly observable in the control groups. The group exposed to x radiation exhibited a preference for water over the saccharin by almost 2 to 1. The learning and/or behavioral aspect of postirradiation aversion in mice is discussed briefly. (C.O.)

51033 HISTOLOGICAL AND AUTORADIOGRAPHICAL OBSERVATIONS OF THE EFFECTS OF X-IRRADIATION ON GILL EPHITHELIUM OF THE GOLDFISH, CARASSIUS AURATUS. Kashiwagi, Masaaki; Etoh, Hisami (National Inst. of Radiological Sciences, Chiba, Japan). Annot. Zool. Jap.; 43: No. 2, 93-101(Jun 1970).

Goldfish, Carassius auratus, were irradiated with 8 kR of X-rays for the investigations of the histopathological and autoradiographical changes in gill epithelium. Reduction in number of interlamellar epithelial cells of the gills was observed within one day after irradiation, whereas number of respiratory epithelial cells reduced on the third day and later. The autoradiographical examination of gill epithelium with ^{3}H-thymidine revealed that this tissue is a cell renewal system. The proliferating cells were found only within the interlamellar epithelium. Cell generation time of the epithelial cells was estimated in intact fish. Number of labeled cells with ^{3}H-thymidine in the gill decreased within 12 hours after irradiation. It was demonstrated that X-rays inhibited mitosis of labeled epithelial cells and destroyed the labeled cells within a short period. On the basis of the present observations, it is highly probable that the gill damage plays an important role in the manifestation of an acute death of goldfish after X-irradiation with doses within the so-called dose-independent range, as the intestinal damage does. (auth)

51034 DEGRADATION AND TURNOVER OF COLLAGEN IN THE MOUSE SKIN AND THE EFFECT OF WHOLE BODY X-IRRADIATION. Obuchi, Kazuo; Tsurufuji, Susumu (Tokyo Univ.). Biochim. Biophys. Acta; 208: 475-81(Jun 1970).

Male mice were given L-[^{3}H]proline intraperitoneally at 4 weeks of age. The total radioactivity of hydroxyproline in the whole body skin increased with time up to the 6th week after the injection, and then gradually decreased to 19.8% of the peak value in the following 50 weeks. The half-life of the labeled skin collagen was calculated as 80 days in mice at 18 to 30 weeks of age, 130 days at 30 to 45 weeks of age and 200 days at 45 to 60 weeks of age, respectively. The degradation of skin collagen in adult mice was accelerated by whole body exposure to a total of 900 or 1200 R of x rays. Exposure to 300 R four times resulted in a 30% increase in the degradation of labeled collagen in the 30 to 60-week-old mice. The total amount of collagen in the whole body skin was also significantly decreased by a total of 900 or 1200 R irradiation. The turnover rate of 1 M NaCl-soluble collagen was higher than that of insoluble collagen and this tendency was amplified by x irradiation. The decrease in the solubility of skin collagen with ageing was accelerated by x irradiation. (auth)

51035 SOME BIOCHEMICAL INDICES OF THE ENERGY AND WATER-SALT METABOLISM IN THE BRAIN OF IRRADIATED ANIMALS. Polyachenko, L. Yu.; Sokolova, V. I.; Dzyubko, N. Ya. (Kiev Medical Inst.). Vrach. Delo; 8: 78-80(Aug 1968). (In Russian).

The effect was studied of sublethal doses of irradiation on the oxidative phosphorylation of mitochondria of the brain and distribution of sodium, potassium and water in the cells and adjoining medium of the cerebral tissue of rats. On the 7-th day of irradiation oxidative phosphorylation of cerebral mitochondria was markedly affected but no distinct changes in the extra- and intracellular contents of the mentioned substances were found. On the 14-th day of irradiation with development of radiation sickness abnormal values of extra- and intracellular sodium, potassium and water in the cerebral tissues coincided with the intensity of decrease of oxidative phosphorylation. At a later time (21-st irradiation day) no correlation between the oxidative phosphorylation changes and distribution of the mentioned ions was seen. By this time the disorders of the water-electrolyte balance are advanced whereas there is a distinct tendency of the oxidative phosphorylation to normalize. (auth)

51036 MORPHOLOGY OF EHRLICH TUMOR CELLS TREATED WITH MAGNESIUM PEMOLINE AND X-IRRADIATION. LeVan, H.; Burlakow, P.; Hebron, D. L. (Univ. of Illinois, Chicago). Oncology; 24: 181-6(1970).

Magnesium Pemoline, a central nervous system stimulant and highly effective radioprotective agent, was found to alter the growth pattern and morphology of Ehrlich tumor cells in mice with or without the additional effect of x irradiation. (auth)

51037 EFFECT OF GAMMA IRRADIATIONS (^{60}Co) ON THE DEVELOPMENT OF CHICK EMBRYOS. NOTE 2. Iozon, Doina; Onea, O.; Marcu, T. (Agronomic Inst., Cluj). Lucr. Stiint., Inst. Agr. Cluj, Ser. Med. Vet. Zooteh.; 23-24: 13-19(1967-68). (In Rumanian).

The mucopolysaccharide modifications that occurred at different stages in the heart, liver, primitive kidney and tegument of Rock white chick embryos, under the influence of γ irradiation (^{60}Co), were studied. Increased mucopolysaccharide synthesis occurred in the heart, mainly at lethal (720 R, 970 R, 1730 R) and inhibitory (50 R, 86 R) doses. At low doses (28 R, 50 R), in all experimented lots, the PAS reactions in the liver were either very feeble or totally missing. The primitive kidney at the age of 97 hours is the organ most generally affected by irradiation. At 72 hours, doses of 50 to 720 R increased the MPZ level in the tegument of the irradiated embryos. (auth)

51038 INFLUENCE OF AGE UPON THE EFFECT OF EARLY POSTNATAL X-IRRADIATION ON THE DEVELOPMENT OF THE CEREBELLAR CORTEX IN RATS. Ebels, E. J. (Univ. of Groningen, Netherlands). Acta Neuropathol.; 15: 298-307 (1970).

Cerebella of young rats of various ages were irradiated. The effect on cerebellar morphogenesis was studied. This effect decreased with increasing age at the time of irradiation. Histological examination of the abnormal cerebella suggests a course of cerebellar maturation that is in good agreement with that obtained by other means. Further physiological and pharmacological investigation of these abnormal cerebella seems highly rewarding. (auth)

51039 EXPERIMENTAL LUNG CANCERS IN RATS AFTER INHALATION OF RADON COMBINED WITH NON-RADIOACTIVE DUSTS. Perraud, Roger (Commissariat a l'Energie Atomique, Razes, France); Chameaud, Jean; Masse, Roland; Lafuma, Jacques. Compt. Rend., Ser. D; 270: 2594-5 (25 May 1970). (In French).

When rats were made to breath a mixture of slightly toxic dusts and radioactive gas, three-quarters of the animals developed lung cancers of different types within 10 and 18 months. (auth) (France)

51040 EFFECTS OF FSH ON THE REGENERATION OF SEMINIFEROUS EPITHELIUM OF X-IRRADIATED BALB/C MICE TESTES. Sylvester, Jay Edward. Washington, D. C.; American Univ. (1969). 31p.

Thesis.

The response to ionizing radiation of seminiferous epithelium of mice testes and its regeneration was investigated. The induction effect of follicle-stimulating hormone (FSH) on the regeneration of x-irradiated seminiferous epithelium has not been well established. In the present study the effect of FSH on the regen-

eration of x-irradiated Balb/c mice testes exposed to 2000 R was investigated. The mice were given injections of 12.5 or 50 micrograms of FSH in an attempt to enhance recovery of the seminiferous epithelium following radiation damage. Seminiferous tubules were typed according to the spermatogenic elements they contained and were expressed as an index of recovery (R). Testicular weight changes were statistically analyzed. The results obtained indicated that no correlation exists between recovery and FSH dose administered; however, recovery did occur within the time limit of the experiment indicating regeneration is dependent upon spermatogonia that escape radiation damage. (auth)

51041 TERATOGENIC EFFECTS OF X IRRADIATION ON VERTEBRAL CHONDROGENESIS IN THE MOUSE EMBRYO. II. MORPHOGENESIS OF ABNORMALITIES BETWEEN DAY 10 AND DAY 18 OF EMBRYONIC LIFE. Novel, Madeleine. Ann. Biol. Anim., Biochim., Biophys.; 9: 627-39(1969). (In French).

A topological and histological study of vertebral development in the mouse embryo was undertaken in order to explain the shapes and distribution of the abnormalities observed after x ray irradiation. The first mechanisms responsible for teratogenesis are pyknosis and temporary cessation of mitosis, that lead to partial destruction of x-ray sensitive areas of skeletal formation. Then the morphogenetic movements are slowed down. A fast resumption of chondrogenesis follows these phenomena, but the reduction of skeleton can occur whenever the damage is the more important. The presence of a physical barrier, e.g., an edema on the pathway of growing cell clusters can result in distortion, or in fusion of two consecutive elements. In other cases the elements are twinned. The latter abnormality occurs only on the part of the vertebral column where chondrogenesis is the fastest. This suggests that the differentiation process started before the morphogenetic movements are achieved. Differentiation therefore appears not to be as much inhibited as morphogenesis. It can however be locally inhibited, as is shown by some involutions of cell activity and delayed ossification. (auth)

51042 CHANGES OF THE RADIORESISTANT THYMIC LYMPHOCYTE POPULATION FOLLOWING X-IRRADIATION OF MICE. Blomgren, H. (Karolinska Institutet Medical School, Stockholm). Exp. Cell Res.; 61: 271-9(Aug 1970).

The changes in size of a population of apparently radioresistant mouse thymic lymphocytes have been investigated after irradiation. Following whole body irradiation, the total number of cells in the thymus varied in a cyclic fashion. The radioresistant population also exhibited a cyclic variation, but the variations were delayed in such a way that size reductions occurred during the regenerative phases of the organ. Bone marrow protection during the irradiation prevented a cyclic regeneration of the total thymus cell population and also of its subpopulation of radioresistant cells. (auth)

51043 DEVELOPMENT OF AMYLASE ACTIVITY IN FETAL RATS (PANCREAS, LIVER, SERUM) IN PLACENTA AND AMNIOTIC FLUID. Goetze, T.; Maennel, G.; Wild, W. (Friedrich-Schiller-Univ., Jena, Ger.). Acta Biol. Med. Ger.; 24: 569-78(1970). (In German).

Amylase activity in the pancreas, liver, plasma, amniotic fluid and placenta of fetal Wistar rats and mother animals has been determined by the amyloclastic method. From day 18 of fetal development until birth, the activity rose in the pancreas, in the serum and the amniotic fluid. The fetal liver shows an increase in activity only after birth. The placental amylase activity which is higher than in the fetal liver, fluctuates but fails to show a clear increase. The fetal pancreas amylase activity per gram of fresh weight is four times that of the mother animal. Whole-body x irradiation with 800 R increases both fetal and maternal pancreas and liver amylase activity and placental amylase activity. The amniotic fluid and fetal serum amylase activity decreases 48 hours following irradiation, returning to the initial level in another 24 hours, whereas the maternal serum activity exceeds the initial value after a transient fall. (auth)

51044 IMPLICATIONS OF RADIATION-INDUCED MODIFICATIONS IN THE COMPARATIVE TERATOLOGY OF THE NERVOUS SYSTEM. Ostertag, B. (Univ., Tuebingen, Ger.). Deut. Z. Nervenheilk.; 197: 239-54(1970). (In German).

An overall account is given of the changes in the nervous system in mouse embryos and in infant mice, brought about by single doses of x radiation. The strictly hemilateral exposure to radiation of the pregnant animal allowed for accurate comparisons (between irradiated and untreated animals of the same litter). As to the teratogenic variation, the age of individual embryos appeared to be more crucial than the duration of the pregnancy. However, it is this variation that makes it possible to study sequentially the dysontogenetic effects when a large number of litters are used. Both a phase specificity in the maturation of organs and, in particular, cortical disorders may be recognized in the already present "anlage" of the pallium. Here deviations, defects, and transient overshooting developments of structures become manifest. The radiation-induced spinal cord lesions correspond to dysphasia found in man at young age. The surviving infant animals (irradiated on the 11th day after conception) are generally retarded compared to their litter mates, displaying multiple malformations and functional lesions of the nervous system in addition to conjugated deformities. (auth)

51045 CHANGE IN COFERMENT ACETYLIZED CONTENT IN DIFFERENT TISSUES OF WHITE RATS IRRADIATED BY SMALL X-RAY DOSES. Tolochko, G. V. (Belorussian State Univ., Minsk). Dokl. Akad. Nauk BSSR, 13: 178-81(Feb. 1969). (In Russian).

The content of acetyl CoA was studied in the tissues of white rats that were subjected to x irradiation in doses of 100 and 40 R. Investigations were carried out through 1 to 24 hr and toward the end of the 7th, 15th, and 30th days after irradiation. The acetyl CoA was determined according to the method of Kaplan and Lipmana, modified by O. N. Sytinskoi, and expressed in micrograms of acetylated p-aminobenzoic acid (PABA) in 1 gm of tissue. It was found that irradiation in a dose of 100 R caused significant changes in the content of CoA. Through 60 min and toward the end of day one after irradiation of brain tissue, a statistically significant reduction in the level of CoA occurred. Then, to the 7th day, its quantity increased significantly, decreasing again between the 15th and 30th day. In the liver and kidneys, the lowering of the content of CoA was manifested toward the end of the first day after the action of x rays. This process continued in subsequent time periods studied. Cardiac muscle responded differently to irradiation. There was a reduction in CoA in it at day one followed by a significant increase to day 7 and by normalization to day 15 after irradiation. Reduction of the dose of irradiation up to 40 R did not change the general direction of disturbances of the concentration of CoA in irradiated tissues. The lowering of the content of CoA in the major hemispheres of the brain was noted at 24 hr and reached significant values at 15 to 30 days after irradiation. An early and stable decrease in the concentration of CoA was found in the liver. (tr-auth)

51046 MECHANISMS OF INJURY FOR RADIATION-INDUCED DECREASE IN COLD TOLERANCE. Phillips, Richard D. (Naval Radiological Defense Lab., San Francisco). J. Appl. Physiol.; 28: 821-5(Jun 1970).

Juvenile male rats exposed to low temperature after x-irradiation (1,000 rad) exhibited a biphasic reduction in cold tolerance in terms of survival time at −17°C. The primary reduction in cold tolerance was evident within the first few hours after x-ray exposure, but with some recovery by 24 hr. A second and more marked reduction in tolerance to acute cold was observed at 3 and 5 days postirradiation. The early reduction in cold tolerance was due to greater than normal heat loss by irradiated animals, reflecting a radiation effect on the vasoconstriction response that normally occurs on exposure to acute cold. The reduced survival times in the cold at 3 and 5 days after x-ray exposure appeared related to radiation-induced changes in food consumption and their sequelae. (auth)

51047 EATING HABITS IN IRRADIATED RATS AND MICE. Yatvin, M. B.; Gerber, G. B. (EURATOM, Mol, Belg. Dept. of Radiobiology, Mol, Belg.). Int. J. Radiat. Biol.; 18: 81-4(1970).

Rats were fasted for 24 hrs, while kept in mesh cages or in bedding cages, and were then whole-body irradiated with 850 R of x rays. After exposure, rats were placed in wire mesh cages where coprophagy was prevented, or in plastic cages with access to feces and bedding. The irradiated rats kept on bedding exhibited marked coprophagy and accumulation of gastric material, but the ones returned to wire cages did not. Non-irradiated rats showed little coprophagy. It was concluded that antiperistalsis contributed not more than 10% to the material found in the stomach after irradiation. Mice kept under similar conditions did not show similar differences in the amount of stomach contents, which were slightly yellowish liquid, whereas in rats the contents were almost entirely of solid material. Similar responses were shown to occur in rats administered Actinomycin D, but it is not clear whether similar mechanisms are responsible. (UK)

51048 MODIFICATION OF RAT TESTICULAR RESPONSE TO X-IRRADIATION BY VARIOUS LIGHTING REGIMES: I. THE PINEAL GLAND AND MELATONIN SYNTHESIS AS A POSSIBLE MEDIATOR OF THE RESPONSE. Ellis, LeGrande C.; Barfuss, Delon W.; Van Kampen, Kent R. (Utah State Univ., Logan. Univ. of Utah, Salt Lake City). Contract AT(11-1)-1602. Life Sci., Part I; 9: 1011-20(1 Sep 1970).

Melatonin synthesis (HIOMT activity) was followed in 12-week-old male rats for 31 days after exposure to 350 R of whole-body x-irradiation. Melatonin synthesis was diminished in rate during the first 24 hrs., but from day-4 through day-19 melatonin synthesis was increased. From day-22 to day-31 melatonin synthesis did not differ from the sham-irradiated animals. Exposure of irradiated rats to 350 R of x-irradiation diminished testicular weight. Placing irradiated rats in constant darkness for 25 days after treatment increased the weight loss that was additive to the irradiation effect. Melatonin synthesis was decreased in these animals when compared to either the control or irradiated rats placed in normal lighting. Placing rats in constant darkness or constant light for 6 days prior to and 19 days after irradiation with 450 R both resulted in an radioprotective effect on the testis. Only the constant-light treated rats showed a change in melatonin synthesis at the time of necropsy, and it was decreased below either the control or irradiated groups. (auth)

51049 EFFECT OF LASER BEAM ON THE MICROMOTILITY OF THE INTESTINAL MUCOSA. Mester, E.; Ihasz, M.; Karika, Gy.; Tota, Jolan G. (Medical Univ., Budapest). Acta Biol. Acad. Sci. Hung.; 21: 171-4(1970).

The effect of exposure to laser rays on the micromotility of the intestinal mucosa was studied. Beams with the energy 1 to 3 J promoted, while doses with energies from 4 to 6 J inhibited, villous automatism. Energy of 7 J caused morphological changes. (auth)

51050 COMPARISON OF 60-MeV PROTONS AND 300-kVp X-RAYS FOR INDUCTION OF LENS OPACITIES IN RF MICE. Darden, E. B. Jr.; Christenberry, K. W.; Beauchamp, J. J.; Bender, R. S.; Jernigan, M. C.; Conklin, J. W.; Upton, A. C. (Oak Ridge National Lab., Tenn.). Radiat. Res.; 43: 598-612 (Sep 1970).

In a study of the relative biological effectiveness (RBE) of protons for late somatic effects in mammals, 8-week-old RF female mice either received whole-body 60-MeV proton or 300-kVp x radiation in single graded doses up to 400 rads or were sham exposed. In a smaller preceding study of cataract induced by lower energy protons (35 and 55 MeV), mice were exposed to high intensity beams of up to 2000 rads of protons or x rays directed largely to the eye or head region. Animals in both groups were examined with the slit lamp for lens changes at appropriate intervals up to one year or more after treatment. Results show that the RBE of 35 to 60-MeV protons is one for induction of lens opacities; that is, low-LET (linear-energy-transfer) particulate and low-LET electromagnetic radiations have the same cataractogenic effectiveness. (auth)

51051 METABOLISM OF GLUCOSAMINEGLYCANS (ACID MUCOPOLYSACCHARIDES) IN RABBITS LUNGS AFTER PLUTONIUM POISONING. Tseveleva, I. A. (Inst. of Biophysics, Moscow). Vop. Med. Khim.; 16: 399-405(Jul-Aug 1970). (In Russian).

The effect of ^{239}Pu inhalation on glucosamineglicanes metabolism in lung tissues of rabbits at two doses, 1.5 and 5 μCi/lungs, was studied. During the first month after inhalation and at the period of intensive sclerosis of the organ the total amount of glucosamineglicanes was increased. This increase was conditioned by the rise in hyalouronic acid, heparin, and especially chondroitin sulfate level. Radiation induced the sharp increase in the metabolic rate of sulfated glucosamineglicanes. (auth)

51052 DETERMINATION OF THE ROLE OF MICROBIAL INTOXICATION IN THE PATHOGENESIS OF THE "INTESTINAL SYNDROME" OF ACUTE RADIATION SICKNESS. Kiselev, P. N.; Meter, I. D. (Central Scientific Research Roentgenoradiological Inst., Leningrad). Radiobiologiya; 10: 395-9(May-Jun 1970). (In Russian).

The role of bacterial lipopolysaccharides of intestinal origin in the development of the intestinal syndrome of acute radiation sickness was investigated. A toxic polysaccharide, producing the death of intact animals, was isolated from lethally irradiated mice by an aqueous phenol method. Acute irradiation increased the sensitivity of the animals to endotoxins during this phase of radiation sickness. The pathomorphological picture of death from endotoxicosis and the intestinal syndrome were demonstrated. (tr-auth)

51053 MORPHOLOGICAL-FUNCTIONAL CHANGES IN THE RAT THYROID GLAND DURING THE LATENT PERIOD OF INJURY BY ^{90}Sr IN THE MINIMUM BLASTOMOGENIC DOSE. Berezovskii, B. S. (Kazan Veterinary Inst.). Radiobiologiya; 10: 434-7(May-Jun 1970). (In Russian).

The changes in the volume of the nuclei of the follicular epithelium, the histological picture, and the iodine-fixing ability of the rat thyroid gland were studied during 210 days of the latent period (for the appearance of tumors) after intraperitoneal injection of 0.05 μCi/g strontium-90. The investigations were conducted on 125 experimental and 130 control rats. It was established that during the investigation period, phase fluctuations in the thyrotropic function of the pituitary are noted, accompanied by the corresponding morphological and functional signs of changes in the secretory activity of the thyroid gland. For the first eight weeks of treatment with the indicated dose of strontium-90, the thyroid function is reduced, while from the 18th week up to the end of the observation it is increased. (auth)

51054 RELATIONSHIP BETWEEN CERTAIN NATIVE PROPERTIES OF EPITHELIUM OF ECTODERMAL ORIGIN AND THE INFLUENCE OF LOCAL X IRRADIATION. Funshtein, L. V. (Central Scientific Research Roentgenoradiological Inst., Leningrad). Radiobiologiya; 10: 441-4(May-Jun 1970). (In Russian).

Local x irradiation of rabbits with therapeutic influenced properties of epithelium of ectodermal origin is described. Ability for proliferation of normal cells was preserved, and recovery was subsequently possible in the epithelium of irradiated skin, even in the presence of radioinduced dystrophy. Tracheal epithelium exhibited an inherited ability for histological accommodation as flat cell metaplasia. (JPRS) (TSS)

51055 HYDROGEN ION CONCENTRATION IN INCUBATED EGGS STORED UNDER GAMMA IRRADIATION. Shkeir, S. D. (Moscow Veterinary Academy). Radiobiologiya; 10: 437-40 (May-Jun 1970). (In Russian).

The experimental and control groups were stored for 15 days. Irradiation of eggs positively influenced the embryonic development of the chicks and increased their survival by 11.72 to 13.72%. Periodic lowering of pH in the yolk and albumen of the irradiated, incubated eggs at definite periods of development is the suggested mechanism for the phenomenon. (tr-auth)

51056 INCORPORATION OF TRITIATED THYMIDINE INTO CHICK EMBRYO FIBROBLAST AND MYOBLASTS SYNCHRONIZED AND IRRADIATED DURING DIFFERENT PHASES OF THE CELLULAR CYCLE. Liebecq-Hutter, S.; Dencel, C.; Beaumariage, M. L. (Univ., Liege). Arch. Biol. (Liege); 80: 139-51(1969). (In French).

Chick embryo fibroblasts and myoblasts were synchronised by selection of mitosis in liquid medium and irradiated (400 R of x rays) during the different phases of the cell cycle, i.e. before DNA synthesis (pre-S or G1), during synthesis (S), after synthesis (post-S or G2) and during mitosis (M). The incorporation of tritiated thymidine was demonstrated by histoautoradiography. When irradiation was administered after the DNA synthesis phase thymidine incorporation was delayed. This delay was even more prolonged following irradiation during mitosis. Except when the cells were irradiated before DNA synthesis the maximal percentage of labeled nuclei was decreased. Unexpected and immediate incorporation of tritiated thymidine was observed when irradiation took place before and after DNA synthesis (G1 and G2). That the isotope may have been used for immediate repair is suggested by: the numerous reports on thymidine incorporation independent of true DNA synthesis as well as those on increased specific radioactivity after irradiation; the fact that the reported periodic activity of DNA synthesizing enzymes does not coincide in experiments with the incorporation of the isotope; the demonstration that cells, fixed after irradiation, were unable to act as primers for DNA synthesis in the presence of calf-thymus DNA polymerase. The chick is rather resistant to x rays and may perhaps be particularly rich in repair enzymes. (auth)

51057 GASTROINTESTINAL MICROFLORA OF IRRADIATED MICE. II. EFFECT OF ORAL ANTIBIOTIC ADMINISTRATION ON THE COLONIC FLORA AND SURVIVAL OF ADULT MICE. Livstone, Elliot M.; Hersh, Theodore; Spiro, Howard M.; Floch, Martin H. (Yale Univ., New Haven). Yale J. Biol. Med.; 42: 448-54(Jun 1970).

Adult white ICR mice were x irradiated with 1200 R and given oral neomycin and penicillin. Control groups were also studied. Segments of colon were obtained 1, 3, 5, 7, and 10 days after the day of irradiation and were studied by light microscopy; at the same times, specimens of colonic feces were obtained for quantitative and qualitative aerobic and anaerobic bacterial cultures. Survivors and nonsurvivors from each group were counted for 30 days. Irradiated adult mice demonstrated significant increase of total aerobic, total anaerobic, and coliform bacteria. The antibiotic regimen eliminated all recoverable bacteria from the fecal samples and permitted the subsequent proliferation of aerobic and anaerobic fungi. The suppression of bacteria in the colonic feces was not associated with prolongation of life nor reduction of mortality in these irradiated mice. It was concluded that tissue damage is more important than bacterial proliferation for the ultimate survival of the host animal. (auth)

51058 INTERPRETATION OF THE APPEARANCE OF ACID SOLUBLE DEOXYRIBOSE CONTAINING COMPOUNDS IN EXPERIMENTAL RADIOBIOLOGY. Tempel, K. (Univ., Munich). pp 45-8 of Biochemisch Nachweisbare Strahlenwirkungen und Deren Beziehungen zur Strahlentherapie. /Gerber, Georg B. (ed.). Stuttgart; Georg Thieme Verlag (1970). (In German).

From Conference on Society of Radiation Biology, Stuttgart, Germany. See CONF-690551.

On the tenth day of development, fertilized chicken eggs were exposed to 878 R x radiation. After an incubation period, varying from 3.5 to 72 hours, they were analyzed for DNAase, DNA, and protein. Following radiation, DNA content and weight of the embryo decreased and DNAase increased. Results are discussed. (H.B.G.)

51059 CHANGES OF HEMATOPOIETIC SYSTEMS FOLLOWING IRRADIATION UNDER OXYGEN OVERPRESSURE (ANIMAL EXPERIMENTAL, ENZYMATIC, AND MICROSCOPIC INVESTIGATIONS). FIRST REPORT. Loehr, E.; Goebbeler, Th.; Magnus, L. (Ruhr Univ., Essen). pp 141-4 of Biochemisch Nachweisbare Strahlenwirkungen und Deren Beziehungen zur Strahlentherapie. /Gerber, Georg B. (ed.). Stuttgart; Georg Thieme Verlag (1970). (In German).

From Conference on Society of Radiation Biology, Stuttgart, Germany. See CONF-690551.

Rats received 750 rad ^{60}Co γ radiation to the lower abdomen and extremities under hyperbaric oxygen conditions of 2 atm. Studies comprised histology of bone marrow, liver, spleen, and heart as well as activity determination of several enzymes. Hyperbaric pressure alone caused increased fat deposition in the liver and significant depression of enzyme activity. Irradiation under hyperbaric conditions caused pronounced periportal fat deposition in the liver and depression of bone marrow; in addition, all enzymes were strikingly suppressed. (H.B.G.)

51060 RECOVERY FROM THE INHIBITORY EFFECT OF X-RADIATION ON URETHAN LUNG ADENOMAGENESIS. Bartlett, Gerald L. (Inst. for Cancer Research, Philadelphia. Univ. of Pennsylvania, Philadelphia). Int. J. Cancer; 6: 56-62 (1970).

Male $(C_3HfB/He \times A/He)F_1$ mice irradiated with 500 R, 24 hrs prior to urethan treatment developed fewer lung adenomas than non-irradiated, urethan-treated mice. When irradiation was given two weeks before urethan treatment, adenoma incidence was the same as in non-irradiated controls, suggesting recovery from the tumor-inhibitory effect of radiation. The recovery was not prevented by thymectomy prior to irradiation. Irradiation of female $(C_3HfB/He \times A/He)F_1$ mice with 500 R did not significantly reduce the number of adenomas induced by urethan. (Denmark) (auth)

51061 RADIATION-INDUCED OSTEOSARCOMA IN THE RAT AS A MODEL FOR OSTEOSARCOMA IN MAN. Cobb, L. M. (Chester Beatty Research Inst., London). Brit. J. Cancer; 24: 294-9(Jun 1970).

A technique is described for the local induction of osteosarcoma in the rat by implanting ^{32}P-impregnated polyvinyl chloride discs into the distal femoral metaphysis. The incidence of osteosarcomata after 18 months was 28%. A comparison is made of the pathology of the radioinduced osteosarcoma in the rat and spontaneous osteosarcoma in man. The possible value of the rat osteosarcoma model is discussed. (auth) (UK)

51062 EFFECT OF COMBINED ETIOLOGIC FACTORS IN EXPERIMENTAL PERIODONTAL LESIONS. Carranza, F. A. Jr.; Simes, R. J.; Cabrini, R. L. J. Periodontal Res.; 4: Suppl. 4, 33-4(1969).

Gingival inflammation was induced in rats by placing a tight nylon ligature around the neck of the lower first molar. A total body dose of 900 rad x rays was administered to rats and they were killed 14 days later. Histologic findings indicated that the marginal irritant is necessary for marginal bone loss to occur; marginal bone loss initiated by the marginal irritant increases significantly when the animal is simultaneously subjected to total body irradiation; the marginal region of interdental bone maintains its normal density in spite of the reduction in bone height; and the submarginal region of interdental bone suffers a process of sclerosis. (H.L.W.)

51063 SELECTION OF CRITERIA TO EVALUATE RADIATION DAMAGE AT DIFFERENT DEPTH: DOSE DISTRIBUTIONS. Grigor'ev, Yu. G.; Savchenko, N. Ya. Kosm. Biol. Med.; 4: 34-9(Jul-Aug 1970). (In Russian).

The influence of a non-uniform distribution of depth doses on the radiobiological effect was investigated in dogs. The internal tissue dose was 20% of the surface dose. A comparison of the biological effect at similar average tissue doses showed significant differences in the clinical picture and severity of the radiation disease. The value of the absorbed bone marrow dose at LD_{50} was 210 to 250 rad, being rather stable in different models of the tissue distribution. (auth)

51064 STUDIES ON THE IDENTITY OF THE HEMATOPOIETIC PRECURSOR CELL. Murphy, Martin Joseph Jr. New York; New York Univ. (1969). 104p.

Thesis.

The hematopoietic precursor cell, despite numerous attempts at precise identification, has remained more a concept than an actuality. Studies are reported utilizing the known ability of homologous marrow cells to prevent death in otherwise lethally x-irradiated mice by "colonizing" their spleens. Those particular marrow cells from which splenic clones arise are, by definition, hematopoietic precursor cells, capable of self perpetuation and deversified differentiation into erythrocytes, granulocytes, and megakaryocytes. The proportion of marrow cells functioning as progenitor cells attains a peak value during post-hypoxic polycythemia. Furthermore, during the first few days following interruption of hypoxia, these cells may be readily labeled by tritiated-thymidine administration. On the third day post-hypoxia, and after daily injections of tritiated-thymidine for the three days, bone marrow of the mice was harvested and prepared for density gradient centrifugation. The relatively pure fractions of marrow cells were now concentrated on the basis of their density and morphologic similarities and directly injected into the surgically-exteriorized spleens of mice which had received an otherwise lethal dose of x-irradiation 48 hours previously. Animals were sequentially killed from 15 minutes to eight days later and spleens were prepared for autoradiographic examination by light and electron microscopy. In autoradiograms of pre-injection cell preparations, labeled, large mononuclear cells were observed. These were characterized by a leptochromatic nucleus with peripheral pachychromia at the nuclear envelope, one or more prominent nucleoli, sparse endoplasmic reticulum, a moderate number of mitochondria, and a sizeable Golgi zone and a centrosome in the region of a nuclear indentation. Cells of this light fraction ($\rho = 1.0380 - 1.0585$), 85 to 90 percent of which were of the cell type just described, and devoid of erythroid elements, were more than 20 times as competent in colonizing spleens (erythrocyte, granulocyte, and megakaryocyte series) than were cells found in fractions of greater density. Autoradiography of post-injection spleens showed labeled mononuclear cells (i.e., now referred to as hematopoietic precursor cells, or HPC) early, and labeled proerythroblasts, myelobiasts and megakaryocytes later. The significance of this cell as the hematopoietic progenitor is discussed in the light of some of the currently proposed models of hematopoiesis. (Diss. Abstr.)

51065 INFLUENCE OF THYROID HORMONE ON THE RESPONSE TO X IRRADIATION OF INTACT RATS, DISPERSED RAT LIVER CELLS, AND RAT LIVER POLYRIBOSOMES. Griffin, Edmond Eugene. Knoxville, Tenn.; Univ. of Tennessee (1969). 77p. University Microfilms Order No. 70-7569.

Thesis.

The purpose of this investigation was twofold in nature. First, an answer was sought to the simple question, does thyroid hormone influence the response of living systems to x-irradiation? Second, if an influence was found, where was the site and what was the nature of interaction in liver tissue at various levels of organization? The experimental data were to provide insight into some cellular processes whereby the mechanisms of action of thyroxine and x-irradiation interact. The administration of physiological doses of thyroxine to hypothyroid rats increased the sensitivity of the animal to x-irradiation by a significant amount. Within 24 hours after x-irradiation the hyperthyroid as well as the hypothyroid animals showed a significant decrease in body weight and rate of oxygen consumption. The mean survival time of hyperthyroid rats was shorter, although not significantly ($P = 0.05$). Dispersed liver cells from rats pretreated in vivo with thyroxine exhibited significantly higher $Q_{O_2}^{Endo}$, incorporated more ^{14}C labeled leucine into protein and ^{3}H-orotic acid into ribonucleic acid than cells from hypothyroid animals. X-irradiation of dispersed cells from hyperthyroid rats caused a significantly greater decrease in amino acid and orotic acid incorporation than in cells from hypothyroid animals. The $Q_{O_2}^{Endo}$ of dispersed cells correlated with the metabolic rate of the intact animal and was decreased more in hyperthyroid cells than in hypothyroid cells. Polyribosomes x-irradiated in vitro exhibited a shift in their sedimentation coefficients toward smaller values and their capacity to incorporate labeled amino acid into protein was lower. However, the exposures necessary to cause these changes were 3 to 30 times higher than those used in the whole animal and dispersed cell experiments. Thus, cellular x-irradiation damage may be due to direct effects on polyribosomes. While some of the nucleic acids and proteins of

cells are damaged directly, other changes such as alteration of the structure and function of cellular membranes may also be an important site of radiation effects. Mitochondrial membranes and their vital enzymatic machinery are highly suspect sites for this type of damage. (Diss. Abstr.)

51066 INHERITANCE OF CELL DIFFERENTIATION DURING LIMB REGENERATION IN THE AXOLOTL. Namenwirth, Marion Ruth Meyer. Bloomington, Ind.; Indiana Univ. (1969). 118p. University Microfilms Order No. 70-7484.
Thesis.

The principal objective of these experiments was to determine whether, when a differentiated vertebrate cell divides, its daughter cells inherit the parental cell type determination. This problem was investigated in the regenerating limb of the axolotl (Ambystoma mexicanum). After limb amputation, the differentiated cells just proximal to the plane of amputation undergo a period of cytological dedifferentiation, giving rise to a blastema of identical-looking cells. These proliferate giving rise to daughter cells which differentiate to form the regenerate. The experiments were carried out by grafting differentiated cells carrying the triploid cell marker (3 nucleoli per interphase nucleus vs. 2), into the limbs of diploid x-irradiated host larvae. The limbs were then amputated through their grafts, allowed to regenerate, and the regenerates examined histologically to determine whether the cells descended from the triploid graft had regained the parental cell differentiation. The x-irradiation of host tissues was intended to give the graft an advantage in supplying cells to the regenerate. Both hindlimbs and the intervening pelvic area were exposed to a 3,000 roentgen irradiation. Neither control irradiated limbs, nor irradiated limbs which received irradiated grafts, were able to regenerate after this dose. When the graft consisted of non-irradiated triploid cartilage, or cartilage with perichondrium, limb-like structures regenerated which contained triploid cartilage, perichondrium, joint connective tissue, and sub-epidermal fibroblasts. Diploid epidermis covered the regenerates, but muscle was completely absent. When triploid cartilage was grafted together with a very small quantity of diploid nonirradiated muscle—enough to initiate muscle regeneration but not enough to swamp out the triploid descendants of the cartilage graft—triploid cells appeared also among the fibroblasts of the regenerated skeletal muscle, but not among the myoblasts. It is therefore concluded that cartilage cells can give rise by mitosis to cartilage, perichondrium, joint connective tissue, sub-epidermal fibroblasts, and fibroblasts in skeletal muscle, but not to myoblasts or epidermis. When triploid thigh muscle was grafted to diploid irradiated limbs, regenerates were obtained which contained all the normal limb tissues, including cartilage. The regenerated mesodermal tissues were triploid throughout, while the epidermis covering the regenerates was of host origin. It is not known which of the various cell types present in whole muscle (myoblasts, fibroblasts, blood cells, nerve sheath cells) is giving rise to the different limb tissues. Triploid epidermis did not promote regeneration, when grafted to irradiated limbs. Triploid skin, however, produced excellent regenerates containing all the normal limb tissues, all of which were triploid. The skin grafts, however, included a few contaminating muscle and connective tissue cells which could have played a role in the regeneration observed. Cartilage from three areas outside the limb was tested for its ability to promote regeneration when grafted to irradiated limbs. Cartilage from the skull did not promote regeneration. Pectoral girdle cartilage gave rise to large, bulbous structures, containing masses of skeletal material arranged in complex patterns of trabeculae and fossae. Cartilage from the pelvic girdle gave rise to limb-like regenerates. In order to determine the extent to which irradiated host cells participate in the regeneration observed, diploid grafts were placed in triploid irradiated limbs, regeneration was permitted to occur, and the regenerates were assayed for the presence of triploid host cells. Except for a very small number of triploid fibroblasts (about 0.2% of all the fibroblasts observed), all the regenerated tissues proved to be diploid. This casts doubt on the theory that irradiated tissues are reactivated by exposure to non-irradiated cells or cell-extracts. (Diss. Abstr.)

51067 CHANGES IN THE EYE LENS CAUSED BY LASER RADIATION. Simakov, Yu. G.; Poluektova, L. M.; Popov, V. V. (Moscow State Univ.). Zh. Obshch. Biol.; 31: 353-60(May-Jun 1970). (In Russian).

The eye lens of the common frog was affected by focused laser radiation at a wave length of 10,600 Å, energy 0.18, 0.12 and 0.04 joules. The irradiation was focused to the lens center. This prevented the irradiation of the equatorial lens zone where fiber differentiation takes place. Under the influence of irradiation there appeared slits and vacuoles (primary damage) on the posterior lens pole. In a week the cataract developed in half of irradiated lenses. The dimming began from the equatorial zone though the ray had not passed through it and had been directed through the lens center and poles. In those eyes where the laser ray affected the iris the cataract of the anterior pole developed. (auth)

51068 ACUTE MORTALITY OF MICE AND RATS EXPOSED TO 14 MeV NEUTRONS. Strike, Thomas A. (Defense Atomic Support Agency, Bethesda, Md.). Radiat. Res.; 43: 679-90(Sep 1970).

Mice (C57BL and C3H) and Sprague–Dawley rats were exposed to 250 kVp x rays or 14 MeV neutrons, and mortality data were collected for 30 days thereafter. The whole-body, bilateral x-irradiations over the range of 378 to 918 rads (midline tissue dose) were delivered at approximately 21 rads/minute. The whole-body rotational neutron irradiations utilized midline tissue doses in the range from 282 to 737 rads. C57BL mice and Sprague–Dawley rats were exposed at a neutron dose rate which varied from 15 to 35 rads/minute (average ~20 rads/minute). C3H mice were exposed at 15 to 50 (average ~20 rads/minute) or 3–5 rads/minute to investigate the possibility of dose-rate effects. Mortality or survival time differences were not observed between sexes, and reported values represent combined groupings. The $LD_{50/30}$ values for x rays and 14 MeV neutrons, respectively, were: C57BL mice 680 and 432 rads; C3H mice, 704 and 537 (3 to 5 rads/minute) or 480 (15 to 50 rads/minute); Sprague–Dawley rats, 810 and 494 rads. The relative biological effectivenesses (RBE) for 14 MeV neutrons using 30-day mortality as the end point for comparison and 250 kVp x rays as the reference radiation were 1.6, 1.5, and 1.6 for C57BL mice, C3H mice, and Sprague–Dawley rats, respectively. A dose-rate effect was evident since the $LD_{50/30}$ value for C3H mice exposed at 15 to 50 rads/minute was significantly lower (480 rads) than that of mice exposed at 3 to 5 rads/minute (537 rads). Of the strains studied only the mean survival time of C3H mice was significantly less when exposed to 14 MeV neutrons at 15 to 30 rads/minute than when exposed to x rays. (auth)

51069 EFFECT OF ACUTE X-IRRADIATION ON THE CELL PROLIFERATION KINETICS OF INDUCED CARCINOMAS AND THEIR NORMAL COUNTERPART. Brown, J. Martin (Churchill Hospital, Oxford). Radiat. Res.; 43: 627-53(Sep 1970).

A detailed study was made of the proliferation kinetics (in particular of the cell cycle time) of chemically induced squamous carcinomas and of the normal epithelium of the cheek pouch of the Syrian hamster. Several different methods, using tritiated thymidine labeling in vivo and standard autoradiographic techniques, were employed to measure the parameters of the cell cycle of the normal and malignant cells both before and after x irradiation. The mean length of the cell cycle of the tumor cells was found to be approximately 12 hours and the mean growth fraction was estimated as 31%. From a comparison of the potential doubling time of the tumors with their measured doubling, a mean cell loss factor of 0.75 was estimated. The range of values obtained for the cell cycle time of the normal epithelial cells was 130 to 152 hours. Following irradiation of the tumors with doses of 500 or 1000 rads it was found that the cell cycle time of the proliferating cells was slightly lengthened, the elongation being primarily a result of increases in the durations of the G_1 and G_2 phases. On the other hand, the same doses delivered to the normal epithelium produced a 20 to 35% shortening of the cell cycle which persisted from three days to approximately three weeks after irradiation. This shortening was almost entirely due to a reduction in the length of the G_1 phase of the cell cycle. (auth)

51070 GAMMA-IRRADIATED VENEZUELAN EQUINE ENCEPHALITIS VACCINES. Reitman, Morton; Tribble, H. R. Jr.; Green, Leonard (Fort Detrick, Frederick, Md.). Appl. Microbiol.; 19: 763-7(May 1970).

The efficacy of Formalin-inactivated Venezuelan equine encephalitis (VEE) vaccine was reported to be low for man. Although a live VEE vaccine was shown to be highly effective for the protection of laboratory workers, local and systemic reactions occurred in approximately 20% of inoculated individuals. Therefore, studies were initiated in an attempt to produce an inactivated vaccine of high potency with low toxicity. Inactivated VEE vaccines were prepared by exposing virus suspensions to 8×10^4 or 10×10^4 R of γ radiation. Irradiated VEE vaccines prepared from virus suspensions produced in Maitland-type chick embryo (MTCE) cell cultures and in monolayer cultures of human diploid strain WI-38 cells were highly immunogenic for mice and guinea pigs. Guinea pigs vaccinated with a series of three inoculations of vaccine (MTCE) survived challenge with at least $10^{3.4}$ mouse intracerebral 50% lethal doses of VEE virus. Irradiated vaccines induced high levels of serum-neutralizing and hemagglutinin-inhibiting antibodies in guinea pigs and rabbits. These findings suggest that ionizing radiation may be effective in the preparation of an inactivated VEE vaccine. (auth)

51071 FEATURES SPECIFIC TO THE MORPHOLOGY OF CHANGES IN THE LUNGS DEPENDING UPON THE DOSE DISTRIBUTION. Kitaev, E. M. (Leningrad Research Inst. on Radiation Protection). Med. Radiol.; 15: No. 9, 13-18(Sep 1970). (In Russian).

Morphological pulmonary changes in irradiation with hot particles and total irradiation of the lung tissue from an external source of radiation were compared. To a certain measure comparable changes in the action of hot particles were observed in the sphere of accumulation of doses greatly exceeding those of external irradiation, employed in the experiment. The principal factor in the reduction of radiation injury in the area of absorption of high energies from the particle is attributed to activation of the repair system of the cells and repair proliferation, the significance of which in the normalization of postradiation changes, apparently, increases with decrease of the volume of irradiated tissue. (auth)

51072 INCREASE OF RADIATION INDUCED LEUKAEMIA IN C57 B1 FEMALE MICE BY INFECTION WITH MAMMARY TUMOUR VIRUS. Squartini, F. (Univ., Pisa, Italy); Bolis, G. B. Nature (London); 227: 400-1(25 Jul 1970).

It is stated that although C57 B1 mice rarely develop spontaneous lymphosarcomas or lymphatic leukaemias, they are highly responsive to the leukaemogenic action of X-rays, and leukaemia induced by radiation can be transmitted by cell free extracts. The agent responsible for such transmission appears to be a virus (radiation leukaemia virus), and important corollaries of this are that the mice harbour an occult or latent leukaemogenic virus and that whole body irradiation causes activation and/or release of this virus. Some studies are described in which female C57 B1 mice at age 40 ± 7 days were exposed to 500 R whole body irradiation in four fractions of 125 R given at 3 day intervals. The numbers and percentages of leukaemia in control and MTV infected animals 120 to 280 days after the first irradiation are shown in tabular form. The incidence of leukaemia was always higher in the infected females than in the controls, whereas there was no significant difference between control and infected males. It is concluded that MTV increases the leukaemogenic activity of radiation in the female mice. (UK)

51073 COMPARATIVE SURVIVALS OF RAT THYROID CELLS IN VIVO AFTER ^{131}I, ^{125}I, AND X IRRADIATIONS. Greig, W. R. (Glasgow Univ.); Smith, J. F. B.; Orr, J. S.; Foster, C. J. Brit. J. Radiol.; 43: 542-8(Aug 1970).

Rat thyroids increase two or three-fold in weight when the animals are exposed to a 28-day goitrogenic stimulus, and the increase is largely due to cell multiplication. Radiation impairs goitrogenic cell proliferation. Thyroid cell survival curves were derived after irradiation with x rays, ^{131}I, and ^{125}I. The D_0 values were 450 rads, 5,500 rads, and 9,400 rads, respectively, where dose refers to the mean dose throughout the gland cells. The extrapolation number for x rays was 1.7, but the curves from ^{131}I and ^{125}I were exponential from the origin. The high D_0 for x rays is explained on the basis of the limited proliferative properties of rat thyroid cells so that D_0 relates to the first or second divisions only. The large difference between values of D_0 for ^{131}I and ^{125}I is explained not by dose-rate nor by RBE but chiefly by the inhomogeneity of the distribution of absorbed dose from the ^{125}I across the follicular cells. For the same cell survival, the nuclei of the follicular cells receive about the same dose from ^{131}I and ^{125}I, but radiation doses from ^{125}I to the cell nuclei are only about half the average doses to the gland and about half the doses to the inner parts of the follicular cells. The dosimetry of ^{125}I is presented in detail. The studies show that cell reproductive integrity is determined largely by the mean dose to cell nuclei irrespective of the dose or dose distribution within the cytoplasm of the thyroid cells. (auth) (UK)

51074 IONISING RADIATIONS AND AGEING. Van Dorp, N. Nucl. Hematol. (Publ. Nucl. Energy); 11: 115-16(Jul-Aug 1970).

An attempt has been made to define the difficulties of comparing the shortening of lifespan observed after irradiation with normal physiological ageing. (UK)

51075 REACTION OF THE ANTERIOR LOBE OF THE HYPOPHYSIS TO IRRADIATION IN CONDITIONS OF ELECTROCOAGULATION OF NEUROSECRETORY NUCLEI OF THE HYPOTHALAMUS. Parshkov, E. M. (Inst. of Medical Radiology, Moscow). Med. Radiol.; 15: No. 9, 34-40(Sep 1970). (In Russian).

The reaction of the anterior lobe of the hypophysis of rats γ-irradiated at a dose of 900 R (55 R/sec) was studied at different periods after simultaneous destruction of supraoptic and paraventricular nuclei of the hypothalamus. (auth)

Man

Refer also to abstracts 50699, 50710, 50760, 50768, 50798, 50820, 50833, 50864, 50873, 50931, 50935, 50939, 50944, 50960, 50961, 51003, and 51044.

51076 (CONF-691212–, pp 387-98) LATE EFFECTS FOLLOWING THE MEDICAL USES OF COLLOIDAL THORIUM DIOXIDE. Swarm, Richard L. (Hoffmann-La Roche, Inc., Nutley, N. J.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

Colloidal thorium dioxide was used as a contrast medium before isotopes or radioactive materials of other types were generally used in medicine. The acute toxic effects of this material were few. However, all isotopes of thorium are radioactive, and late effects include fibrosis and neoplasia. These risks have led to a reduction in the clinical use of colloidal thorium dioxide. In several countries the national government has prohibited or restricted the use of thorium dioxide in man. (auth)

51077 (CONF-691212–, pp 431-40) LATE EFFECTS OF RADIOIODINE THERAPY. Tompkins, Edythalena (Bureau of Radiological Health, Rockville, Md.).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

Findings from the Cooperative Thyrotoxicosis Therapy Follow-Up Study of over 36,000 treated hyperthyroid patients include an age-adjusted leukemia incidence rate per 100,000 patient-years of 11 in the ^{131}I-treated patients and 14 in patients treated by thyroidectomy. There is no evidence of an increased risk of leukemia in this population after total-body doses of 13 to 14 rads. Comparisons of various parameters of the leukemia patients within the study population, including age at risk, time of onset, and chronicity and cell type, revealed only two disagreements between the expected and the observed, both within the ^{131}I population. These were an excess among males of acute leukemia (2.5 expected and 5.0 observed) and a deficit among both sexes of chronic lymphocytic leukemia (4.8 expected and 2.0 observed). The findings in this study of the incidence of leukemia after treatment for hyperthyroidism with ^{131}I are consistent with the two other existing dose–effect studies of radiation leukemogenesis in human adults, i.e., the atomic bomb survivors and the ankylosing spondylitis studies. All three studies fail to demonstrate induction of leukemia at low total-body doses of irradiation. (auth)

51078 (CONF-691212–, pp 441-52) LEUKEMIA IN PATIENTS WITH POLYCYTHEMIA VERA TREATED WITH RADIOISOTOPES. Krauss, Stephen; Wasserman, Louis R. (Mount Sinai School of Medicine, New York).

From Medical Radionuclides: Radiation Dose and Effects Symposium, Oak Ridge, Tenn., Dec 8–11, 1969.

Polycythemia vera (PV) is a chronic hematologic neoplasia characterized by the increased proliferative activity of erythroid, myeloid, megakaryocytic, and fibroblastic cell lines. The early, predominantly erythrocytotic phase often progresses through a phase of myelofibrosis with myeloid metaplasia (MMM) (the so-called "spent" phase), marked by anemia, a leukoerythroblastic blood picture, and hepatosplenomegaly, to an accelerated malignant phase indistinguishable from acute myeloblastic leukemia (AML). It is difficult to ascertain to what extent this description portrays the true natural history of the disease because of the shortcomings of earlier retrospective studies. These include imprecise diagnostic criteria for PV, leukemia, and MMM and the lack of any comparable control patients treated by phlebotomy alone. Current theories on the relation between ionizing radiation and leukemogenesis in PV hold either that (1) ^{32}P, by prolonging life, permits the natural evolution to MMM or AML or both or (2) leukemia in PV results from the action of ionizing radiation on a susceptible population. Firm evidence to support either hypothesis is lacking. Similarly, the effect of chemotherapeutic agents on the course and evolution of PV remains in doubt. Cytogenetic studies in PV reveal chromosomal abnormalities in both irradiated and nonirradiated patients. They may prove valuable in the study of leukemogenesis in PV. Last, the value of and necessity for the current nationwide prospective, randomized study on the use of ^{32}P, chemotherapy, or phlebotomy alone in previously untreated, rigorously diagnosed cases of PV are emphasized. (auth)

51079 (NBS-TN-391) QUANTIFYING HAZARDOUS MICROWAVE FIELDS: ANALYSIS. Wacker, Paul F. (National Bureau of Standards, Boulder, Colo.). Apr 1970. 19p. GPO $0.30.

The existing standards for microwave radiation hazards are based upon far-field concepts that may have little or even no validity in near fields. However, hazards occur largely in near fields, and even many dosimetry experiments are carried out in near

fields. Because of the great complexity possible in a near field, a probe should, in principle, simulate the individual who might be subject to the possible hazard; however, such a probe is not feasible. Electric energy density provides a reasonable index of a large class of microwave radiation hazards and is simpler to measure in a near field than is energy flow. Analytical aspects of near field measurements are discussed in general, and design of a possible probe described in detail. So that near-field dosimetry experiments are meaningful and reproducible, great care must be used in field measurements and describing conditions that determine the field in the subject. (auth)

51080 (UCLA–12-785) IONIZING RADIATION AND VINCRISTINE: POSSIBLE NEUROTOXIC SYNERGISM. Byfield, John E. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). [1969]. Contract AT(04-1)-Gen-12. 23p. Dep. CFSTI.

A case of radiation myelitis occuring in a child who received ^{60}Co γ irradiation at less than four months of age is reported. Dose fractionation was below that in which radiation myelitis has been previously reported when orthodox treatment schedules were used. The patient received coincident vincristine treatments that may have sensitized the central nervous system to otherwise reversible radiation damage developing in the post-radiation period. Radiation myelitis and vincristine neurotoxicity are reviewed, and the suggestion of a potential neurotoxic synergism is briefly discussed. (auth)

51081 RADIATION-INDUCED LYMPHOCYTE-IMMUNE DEFICIENCY. Meyer, Kenneth K. (Guthrie Clinic and Medical Center, Sayre, Pa.). Arch. Surg. (Chicago); 101: 114-21 (Aug 1970).

A systemic effect of localized postmastectomy radiation upon the lymphocyte is described. Total lymphocytes were determined in 103 women preoperatively and two or more years after mastectomy. The total lymphocyte count of those not radiated was unchanged, but in the radiated patients it decreased. At time of recurrence, the count of those not radiated was unchanged and of those radiated showed a decrease. Low counts may persist for more than ten years after radiation. The failure of radiation to improve survival after mastectomy may be a consequence of an induced defect in cellular immunity, as reflected in the decrease of lymphocytes, that negates the tumor destructive effect of radiation. The reported reduction in responsiveness of breast cancer metastases to hormone therapy may be a consequence of the widespread use of postmastectomy radiation. (auth)

51082 THROMBELASTOGRAPHICAL EXAMINATION OF THE EFFECT OF 2000 R GAMMA-RAYS ON BLOOD-CLOTTING FACTORS. Stamm, H. (Univ. of Basel. General Hospital, Baden, Switzerland); Szirmai, E.; Szantay, J. Nucl. Hematol. (Publ. Nucl. Energy); 11: 113-15(Jul-Aug 1970).

Several blood clotting factors were irradiated with 2,000 R γ rays (^{60}Co) and measured blood clotting in recalcified citrated plasma by TEG (thromboelastogram) before and after irradiation. Blood clotting factors were added to the blood of female patients with carcinoma, because blood coagulation of such patients is especially labile. Coagulation activity of factors II, V, VII, VIII, IX and of thrombin remained proportionally unchanged in the non-irradiated as well as after irradiation by γ rays. (auth) (UK)

51083 INFLUENCE OF RADIOIODINE THERAPY ON THE LEVEL OF SH-GROUPS IN THE BLOOD SERUM OF PATIENTS WITH TOXIC GOITER. Semenov, V. D. Med. Radiol.; 15: No. 6, 58-62(Jun 1970). (In Russian).

Studies of the content of SH-groups in the blood serum of 123 patients with toxic goiter revealed a marked increase of this index, mainly at the expense of SH-groups of albumins. The intensity of increase in the concentration of SH-groups correlated with the severity of the clinical course of the disease. After radioiodine administration to patients this index was studied 1, 3, 7, and 10 days later. At the time of treatment there was seen a reduction in the level of SH-groups starting from the third day of treatment and then a subsequent rise. In the albumin fraction of the serum during the first day of treatment the author observed a marked increase in the content of SH-groups with a subsequent sharp decline, whereas the globulin fraction of this index remained augmented. The referred to changes are particularly marked in a severe form of toxic goiter and are significantly weaker in mild cases. (auth)

51084 EFFECTS OF NUCLEAR EXPLOSIONS ON THE HUMAN BODY. Arghittu, Cristino. G. Med. Milit.; 119: 209-40(May-Jun 1969). (In Italian).

After introduction on the phenomena of nuclear weapon a description is given of the injuries caused man by the three main effects that are characteristic of nuclear engines: mechanical, thermic, and radioactive. (C.O.)

51085 THEORY OF NECROTAXIS. Hu, Chia-lun; Barnes, Frank S. (Univ. of Colorado, Boulder). Biophys. J.; 10: 958-69(Oct 1970).

A mathematical theory for the motion of polynuclear leukocytes after the laser irradiation of a red blood cell is derived and compared with the measured movement of a number of cells. An estimate is made on the diffusion constant and the molecular size for the unknown material that communicates the information on the irradiation of the red blood cell to the leukocyte. (auth)

51086 IRRADIATED HUMANS: MICROBIAL FLORA, IMMUNOGLOBULINS, COMPLEMENT (C'3), TRANSFERRIN, AGGLUTININS, AND BACTERIOCIDINS. Balish, Edward; Pearson, Ted A.; Chaskes, S. (Oak Ridge Associated Universities, Tenn.). Radiat. Res.; 43: 729-56(Sep 1970).

The bacterial flora of the nares, throat, skin, and feces of three men was studied after they were accidentally exposed to total-body high-energy x radiation. The three exposure victims were housed in a room equipped with laminar-flow clean benches. Patient A (100 to 200 R) had an episode of pharyngitis that corresponded with the appearance of Escherichia coli in throat cultures; Klebsiella-Enterobacter was the predominant microorganism isolated from his nares. Patient B (550 R) between 19 and 23 days after exposure, had increased populations of Streptococcus salivarius and a pleomorphic Clostridium species in fecal specimens. Patient C (550 R) had a predominance of Klebsiella-Enterobacter in his nares. During oral antibiotic therapy Candida albicans was isolated from both B and C. Victim B had C. albicans on the gums and in the throat during an episode of pharyngitis and gingivitis. The most noticeable changes in the fecal microbial profile appeared to be associated with the anaerobic bacteria. Only patient C, who received a marrow graft from his identical twin, consistently had viable bacteria in his urine. Plasma from the three men was assayed for immunoglobulins (IgG, IgA, IgM), complement (C'3), transferrin, agglutinins, and bacteriocidins. Patient A (100 to 200 R) and patient B (550 R) had good agglutination titers against bacteria isolated from their nares and stool, but no bactericidal effect was evident against the same bacteria. Plasma from patient C (550 R), who received a marrow graft from his twin brother about 8 days after exposure, had the lowest agglutinin titers; but his plasma lost and then regained bactericidal activity. Immunoglobulins, complement, and transferrin levels were also altered, sometimes dramatically, during a 560 day period after the accidental irradiation. (auth)

51087 EFFECT OF RADIATION STRESS ON SKELETAL BONES IN TREATMENT OF PATIENTS WITH LYMPHOGRANULOMATOSIS. Val'kovich, Z. L.; Funshtein, L. V. (Central Research Roentgeno-Radiological Inst., Leningrad). Vop. Onkol.; 16: No. 4, 55-61(1970). (In Russian).

The sternum, vertebrae and ribs irradiated simultaneously in radiotherapy of lymphogranulomatosis of lymph nodes were investigated microscopically. As a result of fractional irradiation of these skeletal portions with total absorbed doses from 800 to 18,900 rad there were observed some changes in the bone marrow and osseous tissue. These were manifested in depression of hemopoietic parenchyma of the bone marrow that occurred with the 2000 R dose and was increasing in larger doses. A dose of 4100 R caused degeneration of osseous structure as a lacunar resorption of spongy trabeculae and destruction of a portion of osteocytes. (auth)

51088 PLEUROPERICARDITIS AFTER RADIOTHERAPY FOR BREAST CANCER. Akoun, G.; Bruhat, M.; Brocard, H. (Hopital Tenon, Paris). J. Fr. Med. Chir. Thorac.; 24: 333-42(Apr 1970). (In French).

A woman aged 31 was treated 20 months before over the left hemithorax, following Halsted's operation. On the same side, the lung became affected by x rays and pleuropericarditis sets in. No proof could be offered as to the origin (tuberculous, carcinomatous, viral) of the effusion or a systemic disorder. Under antibiotics and cortisone, the fluid disappeared in a few weeks, while the ECG anomalies took 16 months to resolve themselves. The real incidence of such effusions has long been contested, but presently it cannot be denied after the recent experimental and clinical surveys. Nevertheless diagnostic steps must be taken with the greatest care, when all the other possible causes of pericarditis have been rejected. The knowledge of radiotherapy over the left chest is of course outstanding. The best way to treat it is corticotherapy. But we know next to nothing on this particular subject. (auth) (France)

51089 OSTEOGENIC SARCOMA INDUCED BY RADIATION. Dige, Ulrik. Ugeskr. Laeger; 132: 1271-4(1970). (In Danish).

A case of osteogenic sarcoma induced by radiation is presented. The sarcoma developed in a clavicle following post-operative radiation therapy for cancer of the breast. The analogous cases in the literature are reviewed in the light of the expression post-radiation bone sarcoma. (auth)

51090 IRRADIATION INJURY TO THE BOWEL AND RECTUM. Blank, W. A. (St. Vincent Hospital and Medical Center, Toledo). Proc. Roy. Soc. Med.; 63: 98-9(1970).

Irradiation damage to the rectum and sigmoid colon is a complication which develops in a significant number of instances despite recent improvements in methods and techniques in the treatment of uterine and cervical carcinoma with radium and cobalt. In a large percentage of cases the irradiation damage appears in 2 to 6 weeks, and many of these will heal spontaneously or respond satisfactorily to steroid retention enemas. These patients all need reassurance that their symptoms are not due to a recurrence of their original cervical or uterine carcinoma. A colostomy should be used to relieve obstruction or to supplement repair or anastomosis. Pain, hemorrhage and fistula formation are not relieved by colostomy. Tissues affected by irradiation heal poorly; hence the necessity for supplementing resections and repair work with a diversionary colostomy. (auth) (UK)

51091 RADIATION INJURIES OF THE LUNGS IN THE TREATMENT OF CANCER OF THE ESOPHAGUS. Tikhonov, K. B.; Rabinovich, R. M.; Gerasimyak, V. G. (Central Research Inst. of X-Ray-Radiology, Moscow). Med. Radiol.; 15: No. 9, 8-12(Sep 1970). (In Russian).

The results of clinico-roentgenological observations of over 100 patients with cancer of the esophagus who were treated with megavolt bremsstrahlung are presented. Pathological processes in the lungs, associated with the injurious effect of radiation, were revealed in 63 patients. In accordance with the principal roentgenological sign in 68 percent of cases the pathological process in the lungs was characterized by diffuse infiltrative changes. The pathological process was situated on both sides of the cardiovascular shadow which resembled butterfly wings. Symmetry in the localization of pathological changes was not noted. Corresponding to clinico-roentgenological manifestations of the disease, the radiation injuries were considered as acute (76.2%) with transition into secondary chronic pneumonia and primary chronic (23.8%). (auth)

Radiation Effects on Plants

Refer also to abstracts 50705, 50712, 50772, 50804, 50806, 50809, 50811, 50812, 50822, 50824–50829, 50834–50836, 50838, 50843–50847, 50849, and 50860–50862.

51092 (JUL-638-BO) INVESTIGATION OF THE EFFECTS OF X RAYS ON THE LIGHT-DEPENDENT DIFFERENTIATION OF ETIOPLASTS TO CHLOROPLASTS. Sprey, Benno (Kernforschungsanlage, Juelich (West Germany). Institut fuer Botanik und Mikrobiologie). Jan 1970. 187p. (In German). Dep. CFSTI (U. S. Sales Only).

Seedlings of Hordeum vulgare were cultivated for five to six days in the dark and then exposed to x radiation. Induced by subsequent exposure to light, differentiation of etioplasts to chloroplasts was studied by light microscopy, electron microscopy, and ^{14}C labeling of various compounds. Significant inhibition of the process required doses ranging from 100 to 500 kR. Most characteristic were delay in the lagphase of chlorophyll synthesis, delay in CO_2 assimilation, and quantitative alterations of ^{14}C-labeled intermediary products in the reductive pentose-phosphate route. The alterations indicated inhibition of light-induced syntheses of enzymes involved in the Calvin cycle. To study the mechanism of radiation effects, various chemical inhibitors were used to block synthesis of DNA, RNA, and proteins. (H.B.G.)

51093 A STUDY OF THE EFFECTS OF DIFFERENT LEVELS OF CARRIER-FREE ^{89}Sr IN THE SOIL ON THE GROWTH AND DIFFERENTIATION OF PLANT ORGANS. II. EFFECT ON PEA AND LETTUCE TOPS. Younis, A. F. (Univ. of Alexandria, Egypt). Isotope Radiat. Res.; 2: 71-77(Jun 1969).

Germinated pea and lettuce seeds were grown in soils containing different amounts of ^{89}Sr to give β activities of 3, 6, 9, 12, 15, 18, and 21 μCi/g soil at the time of planting. After five weeks, all plants were harvested and studied morphologically and histologically. In lettuce, the leaf area and fresh weights of tops were higher in the 6 and 9 μCi plants, and in pea, the leaf area in the 9 and 12 μCi plants was higher than in the other treatments including controls, pointing to a threshold level of β activity at the range of 6 to 12 μCi/g soil. An interesting feature, probably not recorded before, was observed in the stem apex of lettuce, namely, the formation of a twin growing point within the same apex in the 6 to 18 μCi plants; photomicrographs of these heads are presented. (auth)

51094 ADVANCED INITIATION OF SYNCHRONOUS MITOSES IN PHYSARUM POLYCEPHALUM FOLLOWING UV-IRRADIATION. Sachsenmaier, W.; Doenges, K. H.; Rupff, H. (Deutsche Krebsforschungszentrum, Heidelberg. Princeton Univ., N. J.). Z. Naturforsch.; 25b: 866-71(Aug 1970).

Irradiation of multinuclear synchronous plasmodia of Physarum polycephalum with uv light (2000 to 7000 ergs/mm^2, λ max 2537 Å) at any time during the first two-thirds of the mitotic cycle (S period and early G_2 period) delays the onset of the next nuclear mitosis by 1 to 3 hr (10 to 30% of the normal cycle). The initial delay of the mitotic schedule is overcompensated by the advanced initiation of subsequent mitoses. This remarkable shortening of the nuclear division cycle very likely is related to the selective destruction of some irradiated nuclei during the first postirradiation S period. Since the increase of total protein is little affected, the ratio of protein/DNA (cytoplasm/nuclei) is increased after the uv treatment. A model is discussed suggesting that the onset of nuclear mitosis is controlled by a cytoplasmic factor that accumulates during interphase at a rate proportional to the increase of the total plasmodial mass. (auth)

51095 EFFECT OF ACUTE GAMMA RADIATION ON THE BACTERIAL NODULES FORMATION OF PEAS (PISUM SATIVUM). Abdel-Al, Z. E.; Hani, B. M.; Hamdy, S. (Alexandria Univ., Egypt). Isotope Radiat. Res.; 2: 79-83(Jun 1969).

Seeds of peas of Little Marvel variety were exposed to 0, 1, 2, 3, 4, 5, 6, 10, 15, 20, 25, and 30 kR of γ radiation from ^{60}Co source at Inshas Atomic Energy Establishment. The experiment layout was a randomized block design with four replications. The roots of 10 plants in each replication were examined 50 days after sowing. The number of galls of bacterial nodules per plant was counted. The results showed that the low doses of γ radiation, such as 3, 4, and 5 kR, resulted in significantly greater average number of bacterial nodules per plant than most other treatments. Increasing the γ radiation doses beyond 5 kR resulted in a significantly lower number of bacterial nodules per plant. The significance of this study could be of great importance, if commercially applied by exposing the seeds of peas to low doses of γ radiation before planting in order to stimulate bacterial nodule formation and consequently increase yield. Accordingly, this treatment might cut down the amount of nitrogen fertilizers needed. (auth)

51096 STUDIES ON THE USE OF MUTAGENIC AGENTS IN LUPINUS. I. THE EFFECT OF GAMMA-RAY DOSE ON PLANT SURVIVAL IN L. ANGUSTIFOLIUS, L. ALBUS, L. LUTEUS, AND L. MUTABILIS. Pakendorf, K. W. (Stellenbosch-Elsenburg Coll. of Agriculture, South Africa). Z. Pflantzenzuecht.; 63: 102-13(Apr 1970).

Dry seeds of the lupin species Lupinus angustifolius, Lupinus albus, Lupinus mutabilis and Lupinus luteus were irradiated with γ rays at doses varying between 0 and 200 kR in the period 1966 to 1968. Regular plant survival counts were made during the entire vegetation period. The results indicate that L. angustifolius and L. albus can tolerate doses in excess of 100 kR, while total lethality is achieved in L. mutabilis and L. luteus at this dose. The order of resistance to γ irradiation in the species was found to be L. angustifolius > L. albus > L. mutabilis > L. luteus. The results further indicate a definite stimulation of germination and survival at low doses of irradiation as compared to the control plots. (auth)

51097 RELATIVE BIOLOGICAL EFFICIENCY OF 14.1 MeV FAST NEUTRONS AND ^{137}Cs GAMMA RAYS IN THE PRE-SOAKED SEEDS OF TRITICUM BOEOTICUM BOISS. AND ITS AUTOTETRAPLOID. Ichikawa, Sadao (Kyoto Univ.). Jap. J. Genet.; 45: 217-24(Jul 1970).

Seeds of Triticum boeoticum, a diploid wheat species, and of its autotetraploid were soaked for 14 hrs at 20°C and were irradiated acutely with appropriate doses of 14.1 MeV fast neutrons or of ^{137}Cs gamma rays. The effects of both the radiations were compared based on the data of seedling height measured 31 days after irradiation and of wet and dry weights of 49-day-old seedlings. The RBE values of 14.1 MeV fast neutrons as compared with ^{137}Cs gamma rays were determined to be 3.12, 3.48 and 3.52 for the reduction of seedling height, wet weight and dry weight, respectively, in the diploid, and 2.66, 2.80 and 2.74, respectively, in the autotetraploid. These values are evidently lower than those obtained earlier from dry seeds, and it is obvious that water content modifies RBE value. (auth)

51098 EFFECT OF PRESOWING X IRRADIATION OF SEEDS ON THE GROWTH AND DEVELOPMENT OF THE PEPPER

(CAPSICUM ANNUUM). Batikyan, G. G.; Saakyan, T. A.; Terzyan, R. T. (Erevan State Univ.). Biol. Zh. Arm.; 23: No. 3, 13-17(Mar 1970). (In Russian).

Experiments were conducted with two types of pepper seeds Bulgarian 079 and Elephant Trunk 304 exposed to x radiation of 500, 1,000, 5,000, 10,000, 15,000, 20,000, and 30,000 R during 1965, 1966, and 1967. Data obtained showed that for the pepper seeds, irradiation with 30,000 R proved absolutely lethal and with 20,000 R critical. Optimum doses for these seeds were 500 and 1,000 R. These doses stimulated germination of the seeds, intensified the growth of plants, and amplified the harvest, however, irradiation of seeds had a negative effect because it reduced the content of ascorbic acid in the pepper. (R.V.J.)

51099 INFLUENCE OF CHRONIC GAMMA-IRRADIATION ON NODULATING SOYA. Hamatova, E. (Research Inst. of Crop Production, Prague). Rostinna Vyroba; 15: 197-200(Feb 1969). (In Czech).

Inoculated soybean plants were cultivated in a γ field, and exposed during vegetation to chronic irradiation with γ rays in doses decreasing gradually from 5454 R to 59 R. The influence was investigated of irradiation on the weight of the dry matter of the plants, on the accumulation of nitrogen in the plants, and on the number, volume, and weight of nodules formed during one and two passages of the inoculation strain of Rhizobium japonicum through irradiated plants. The second passage of R japonicum through irradiated soybean showed a higher effectivity of symbiosis than was the case with the first passage. A remarkable increase of nodulation and of the effectiveness of symbiosis was found particularly in the case of irradiation of plants with low doses of γ rays (295 to 71 R) during vegetation. (NSA of Czech.)

51100 RADIOPROTECTIVE EFFECTS OF ACTINOMYCIN D IN EXPERIMENTS WITH PLANTS. Grodzinskii, D. M.; Gudkov, I. N. (Inst. of Plant Physiology, Kiev). Radiobiologiya; 10: 453-6(May-Jun 1970). (In Russian).

Actinomycin D (10 mg/L) has a radioprotective effect on pea seedlings exposed to γ radiation at doses of 800 rad for 30 hrs in a nutrient mixture containing the antibiotic. Supplementary exposure of the seedlings to actinomycin D in the postradiation period enhanced the radioprotective effect. Recovery was accelerated in proportion to the time interval of exposure to the antibiotic up to 10 hrs. (JPRS) (TSS)

51101 INFLUENCE OF ^{90}Sr ON POTATO YIELDS. Zuev, N. D.; Ponomareva, R. N. Radiobiologiya; 10: 456-8(May-Jun 1970). (In Russian).

Data were obtained on the dependence of the growth, development, yield, and viability of potato tubers upon the density of contamination of the soil by strontium-90. The greatest injurious effect among the plants is observed at contamination levels of 250 and 1250 mCi/m^2. (auth)

51102 GAMMA-RAY-RESISTANT AND -SENSITIVE STRAINS OF SLIME MOLD (DICTYOSTELIUM DISCOIDEUM). Deering, R. A.; Smith, M. S.; Thompson, B. K.; Adolf, A. C. (Pennsylvania State Univ., University Park). Radiat. Res.; 43: 711-28(Sep 1970).

The vegetative cells and spores of the cellular slime mold Dictyostelium discoideum NC-4 are very resistant to ^{60}Co γ rays, with a 10% survival dose (D_{10}) of 300 krad in air. Using uv light or nitrosoguanidine as a mutagenic agent and replica plating with γ irradiation as a selective agent, several stable daughter strains were isolated that are more sensitive to γ rays. A comparison of some of the radiation responses of the parent (NC-4; wild type), γs-18 (D_{10} = 75 krad), and γs-13 (D_{10} = 4 krad) strains was made. All three strains showed the same γ-radioinduced division delay of about one cell generation time for 54 krad. Strains wt (wild type) and γs-18 showed split-dose recovery of colony-forming ability but γs-13 did not. For wt, this recovery was temperature-dependent with a maximum at 23°C, the most favorable growth temperature. Some recovery still occurred at 5 to 10°C, although growth did not. Strains wt and γs-18 were more sensitive when irradiated in oxygen or air compared with nitrogen. The sensitivity of γs-13 was the same in air, oxygen, or nitrogen. Postirradiation treatment with 1 mg caffeine/ml before plating sensitized wt and γs-18 but increased the survival of γs-13. Strain γs-13 was more sensitive to killing by nitrosoguanidine than was wt or γs-18. These results suggest that γs-13 is more sensitive than wt because it is less capable of repairing γ-ray and other damage and that γs-18 is intermediate in this ability. (auth)

51103 COMPARISONS OF RADIOSENSITIVITY OF LEAN AND CLOVER SEEDS. Seisebaev, A. T.; Mal'tsev, A. V. (Inst. of Biophysics, Moscow. Inst. of Experimental Biology, Alta-Ata, USSR). Izv. Akad. Nauk Kaz. SSR, Ser. Biol.; No. 2, 78-82(1969). (In Russian).

Experimental data obtained showed that air-dried beans (Leguminosae) were 20 times more radiosensitive to γ irradiation than red clover seeds. The inhibiting dose for the beans was 10 kR while for the red clover seeds it was 200 kR. Irradiation with 10 kR doses inhibited the initial mitosis of the embryo root meristem for 12 hr but it did not affect the mitosis in red clover. Identical irradiation with 10 kR induced 54.27% of chromosome reconstruction of the first root mitosis in radiosensitive bean seeds and only 15.10% in the red clover. (R.V.J.)

51104 MUTATIONS IN QUANTITATIVELY INHERITED TRAITS INDUCED BY NEUTRON IRRADIATION. Brock, R. D. (Commonwealth Scientific and Industrial Research Organization, Canberra, Australia). Radiat. Bot.; 10: 209-23(Jun 1970).

The majority of studies involving quantitatively inherited variability induced by neutrons have been made with thermal neutrons and have been associated with attempts to select useful mutants in self-fertilizing species of plants. Neutrons induced similar amounts and types of variability to that induced by low LET radiations. In comparison with efficient chemical mutagens, neutrons induced somewhat less variability and there were some suggestions of mutagen specificity. The results currently available indicate that neutrons induce variation in quantitatively inherited traits and that economically useful mutants can be selected. In the absence of conclusive evidence regarding qualitative and quantitative differences from other mutagens, neutrons should be included in future experiments. The differences in quantitatively inherited variability induced by different mutagens did not parallel the large differences that are observed when chromosomal and gross mutagenic changes are recorded. This is probably a consequence of the additional selection which is imposed before quantitatively inherited variability is studied. Attempts to determine the nature of the genetic changes induced by neutrons have not been conclusive. Genetic correlations and RBE values suggest that the changes leading to quantitatively inherited variability are predominantly chromosomal rather than genic. Further studies on quantitatively inherited systems, particularly with fast neutrons where the problems of dosimetry are simpler, and experiments designed to establish RBE values for single gene mutations in microorganisms should add to knowledge of the nature of the genetic events contributing to quantitatively inherited variation. (auth) (UK)

51105 SURVIVAL OF uvsB AND uvsC MUTANTS OF ASPERGILLUS NIDULANS AFTER UV-IRRADIATION. Jansen, G. J. O. (State Univ., Utrecht). Mutat. Res.; 10: 21-32(Jul 1970).

The isolation, location, and survival characteristics of two uv sensitive mutants of Aspergillus nidulans (uvsB10 and uvsC14) are described. The mutations uvsB10 and uvsC14 are located on chromosome IV and chromosome VIII, respectively. Resting uvsC14 and uvs$^+$ conidia are equally sensitive to inactivation by uv light. Resting uvsB10 conidia are more uv sensitive than resting uvsC14 and uvs$^+$ conidia. At comparable growth stages, germinating uvsC14 conidia are more uv sensitive than germinating uvs$^+$ conidia, and germinating uvsB10 conidia are still more sensitive than germinating uvsC14 conidia. The uv sensitivity of uvsB10 and uvsC14 conidia strongly increases during germination, whereas the sensitivity of uvs$^+$ conidia only slightly fluctuates. Both uvsB10 and uvsC14 are recessive to their wild type alleles in diploids. The mutant uvsB10 may be defective in excision repair of uv damaged DNA; uvsC14 may be defective in recombination repair. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 50711, 50738, 50742, 50764, 50767, 50771, 50814, 50816–51819, 50823, 50830, 50831, 50848, 50855, 50856, 50952, and 51099.

51106 MULTIPLICITY REACTIVATION IN GAMMA IRRADIATED MYXOVIRUSES. Pavilanis, V.; Gilker, J.-C.; Ghys, R.; Chagnon, A. (Univ. of Montreal). Progr. Immunobiol. Stand.; 3: 64-9(1969).

Experiments showed that inactivation of myxoviruses with γ rays is dose and temperature dependant. The tailing effect observed in γ-irradiated influenza A viruses is explained as the result of multiplicity reactivation. (auth)

51107 PHOTOREACTIVATION AND UV REACTIVATION OF PHOTOCHEMICAL DAMAGES TO BACTERIOPHAGE Φ X174. Likhacheva, N. A.; Zavil'gel'skii, G. B.; Il'yashenko, B. N. (Inst. of Epidemiology and Microbiology, Moscow. Inst. of Molecular Biology, Moscow). Radiobiologiya; 10: 409-15(May-Jun 1970). (In Russian).

Photoreactivation (PR) of a phage with single-stranded DNA, Φ X174 was studied on bacteria hcr$^+$ and hcr$^-$. When Φ X174 was inoculated on strain hcr$^-$, 40% of the DNA damage was photore-

activated. Ultraviolet reactivation and mutagenesis were also investigated in Φ X174. The hcr system was determined to be essential for mutagenesis in the phage when bacteria were challenged by supplementary irradiation. (JPRS) (TSS)

51108 DEMONSTRATIONS OF THE ROLE OF POST RADIATION RECOVERY IN THE RADIORESISTANCE OF BACTERIA OF VARIOUS STRAINS. Petin, V. G.; Myasnik, M. N.; Morozov, I. I. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya; 10: 416-21(May-Jun 1970). (In Russian).

The literature on the role of postradiation recovery in the radioresistance of bacteria of various strains is reviewed. It was shown that the differences of the radiosensitivity of the E. coli strains B/r, B, and B_{s-1} are determined by preirradiation culturing conditions, rather than LET of the radiation. The decrease in the resistance of E. coli B/r to x irradiation after preliminary α-irradiation was not necessarily associated with a suppression of the repair systems. It was concluded that the different radiosensitivities of E. coli B/r, B, and B_{s-1} are difficult to explain solely from the standpoint of their different abilities for postradiation recovery. (JPRS) (TSS)

51109 CHANGE IN THE SENSITIVITY OF BACTERIAL CELLS TO ULTRAVIOLET AND GAMMA RADIATION DURING AGING. Vilenchik, M. M. (Inst. of Biological Physics, Pushchino, USSR). Radiobiologiya; 10: 450-2(May-Jun 1970). (In Russian).

Bacterial cultures in the stationary phase of growth were irradiated with various doses; uv was used for Micrococcus radiodurans and γ irradiation for Escherichia coli B. In both cases the survival curves of young cells had a shoulder that was absent on the survival curves of old cells. (tr-auth)

51110 INFLUENCE OF RADIOTOXINS ON THE X-VIRUS OF THE POTATO. Anokhin, V. M. (Inst. of Microbiology and Virology, Kiev). Radiobiologiya; 10: 458-60(May-Jun 1970). (In Russian).

Radiotoxins (RT) extracted from γ-irradiated potato tubers inactivate the x-virus of the potato (XVP) in vitro to a considerably greater degree than extracts (EX) from nonirradiated tubers. Radiotoxins inhibit XVP in vivo and cannot be used for chemotherapy of virus diseases of plants. It is believed that the mechanism of the inactivation of XVP is analogous to the viral action of orthoquinoids and is based on oxidation-reduction reactions. (tr-auth)

51111 STUDIES ON HOST CELL REACTIVATION OF PREMUTATIONAL LESIONS AND MARKER RESCUE IN UV-IRRADIATED EXTRACELLULAR BACTERIOPHAGE LAMBDA. Kriviskii, A. S.; Ktsoyan, Zh. A.; Matvienko, N. I. (Inst. of Molecular Biology, Moscow. Inst. of Experimental Biology, Erevan). Genetika; 6: No. 2, 110-22(Feb 1970). (In Russian).

The relative role of multiplicity reactivation and of cross reactivation (marker rescue) in uv-induced vir-mutants in λ_{11} bacteriophage was studied using hcr^+ and hcr^- Eschhericia coli K-12 (λ). It was demonstrated that under experimental conditions employed, there was practically no multiplicity reactivation, while the rescue of vir marker by the λ prophage was very pronounced both on hcr^+ (λ) and hcr^- (λ). (C.H.)

51112 INACTIVATION OF GROSS LEUKEMIA VIRUS BY UV, X, AND γ-RADIATION. Latarjet, Raymond (Institut du Radium-Biologie, Paris). Int. J. Cancer; 6: 31-9(1970). (In French).

A passage cell-free extract from AKR leukemia was irradiated with uv light (2,537 Å), with x and γ-radiation acting under direct effect conditions. After irradiation, the residual activity of the extract was compared to those of serial dilutions of the nonirradiated extract. The criterion for activity was the acceleration test in new-born AKR mice. Four experiments were carried out with uv light, 3 with x, and 2 with γ-rays. In each experiment the effects of 4 doses of radiation were compared to those of 4 10-fold dilutions of the non-irradiated control. In all, 1,835 newborn mice were utilized. The Gross virus is inactivated according to an exponential function of the dose of radiation. The doses D_{10}, which reduce the viral activity of the extract to one tenth of its original value, were found to be: uv: 14 ± 1 kilo ergs mm^{-2}, x and γ (direct effect): 600 ± 100 kR. The viral function, which is involved in these tests, seems to be the leukemogenic activity (transformation), rather than the infectivity (viral multiplication). (Denmark) (auth)

51113 RESCUE OF HEAT-INACTIVATED ADENOVIRUS TYPES 1 AND 6 BY ULTRAVIOLET-IRRADIATED ADENOVIRUS TYPE 8. Beladi, Ilona; Mucsi, Ilona; Bakay, Marta; Pusztai, Rozalia (Univ. Medical School, Szeged). J. Gen. Virol.; 7: 153-8(1970).

Heating human adenovirus types I and VI at 56° reduced infectivity very rapidly. A treatment for 10 to 15 min usually completely destroyed the infectivity. However, the rescue of heated virus occurred when HEp-2 cells were inoculated simultaneously with heat-inactivated type I or VI and uv-irradiated type VIII. Rescue was dependent upon the length of heat treatment, as viruses heated at 56° for more than 20 min could not be rescued. On the other hand, the rescue of heat-inactivated type VI was related to the uv dose employed, i.e. type VIII unirradiated or irradiated for 20 min was not suitable for rescue. The possible mechanism of rescue observed with heat-inactivated adenovirus types I and VI by uv-irradiated type VIII is discussed. (auth) (UK)

51114 RELATION BETWEEN RADIATION STABILITY AND DNA REPLICATION OF PHAGE T_4. Ritchie, D. A. (Univ. of Glasgow); Symonds, N. J. Gen. Virol.; 8: 121-31(Aug 1970).

Two types of experiments were made during the early part of the latent period on a culture of cells singly infected with phage T_4. First, samples taken from the infected cells at different times were irradiated with uv light in order to obtain a set of Luria-Latarjet curves. Secondly, and with the same culture of infected cells, the kinetics of phage DNA synthesis was followed using a density gradient technique. A comparison of these results suggests that the radiation stability shown by the Luria-Latarjet curves is first detectable at about the time that phage DNA synthesis commences. The radiation stability, however, increases at a rate that is much faster than the rate of replication of the parental phage DNA. (auth) (UK)

51115 REPRODUCTIVE AND CELL-TRANSFORMING CAPACITIES OF AVIAN SARCOMA VIRUS B77: INACTIVATION WITH UV LIGHT. Toyoshima, Kumao; Friis, Robert R.; Vogt, Peter K. (Univ. of Washington, Seattle). Virology; 42: 163-70 (Sep 1970).

Avian sarcoma virus strain Bratislava 77 (B77) was irradiated with ultraviolet light, and virus survivors were studied for their ability to transform cells and to reproduce. Two classes of radiation-damaged particles were found. One can still transform but fails to reproduce; the other reproduces but cannot transform. The first class of particles also fails to induce the synthesis of noninfectious virus. It cannot be rescued by superinfection of the transformed cells with an avian leukosis virus, and it is unable to maintain the transformed state during prolonged culture. The second class of particles is antigenically indistinguishable from B77, interferes with avian sarcoma viruses of subgroup C and produces pseudotypes with RSV(0). (auth)

Radiosterilization and Radiopreservation

Refer also to abstracts 50321, 50499, 50524, 50671, 50672, 50724, 50725, 50774, 50776, 50783, 50784, 50786–50791, and 51020.

51116 (ORO-675) EFFECTS OF LOW LEVEL IRRADIATION UPON THE PRESERVATION OF FOOD PRODUCTS. Annual Report, April 15, 1967-April 14, 1968. Ahmed, E. M.; Dennison, R. A.; Merkley, M. S. (Florida Univ., Gainesville. Dept. of Food Science). Apr 1968. Contract AT(40-1)-3097. 123p. Dep. CFSTI.

Shipping and radiation processing of citrus fruits for a distance of about 1000 miles did not result in increased injury to the peel, differences in increased injury to the peel, differences in pH, titratable acidity, soluble solids and reduced ascorbic acid contents or differences in flavor. Citrus fruits irradiated with an average 150 Krad dose showed increased peel injury. However, with storage of the irradiated fruit at 35°F the severity of peel injury was less than when stored at 50° and 65°F. A 10 to 17% loss of reduced ascorbic acid content occurred in Valencia oranges and Duncan grapefruit due to irradiation. However, losses of this acid in unirradiated fruit stored at 50 or 65°F were more pronounced than that due to irradiation. No differences were observed in the amounts of soluble solids and titratable acidity between the irradiated and the unirradiated citrus fruits. Juice expressed from irradiated Duncan grapefruit had greater viscosity than from unirradiated fruit. Citrus fruits irradiated with doses up to 150 Krad exhibited acceptable organoleptic quality. Irradiated Bearss lemons changed with progressing maturity from yellowish-green color to greenish-yellow color at a faster rate than the non-irradiated fruit. Floradel tomatoes irradiated at the stage of color break showed a 2-day delay in reaching the orange-pink color as compared to control fruit. Irradiated Bearss lemons and Duncan grapefruit showed increased respiratory activity; reaching a maximum after 42 and 30 hours, respectively. Irradiation (150 to 225 Krad) treatments as well as hot water treatments (3.5 to

7 minutes @ 120°F) were effective in decay control of Dixieland and Loring peaches. Irradiation doses ranging from 50 to 200 Krad appeared effective in reducing the survival of yeast cells (Saccharomyces cerevisiae var. ellipsoideus) present in orange juice. (auth)

51117 (ORO-677) EFFECTS OF LOW LEVEL IRRADIATION UPON THE PRESERVATION OF FOOD PRODUCTS. Annual Report, April 15, 1968-June 30, 1969. Ahmed, E. M.; Dennison, R. A.; Merkley, M. S. (Florida Univ., Gainesville. Dept. of Food Science). Jul 1969. Contract AT(40-1)-3097. 200p. Dep. NTIS.

Hot-water dip and waxing treatments reduced the incidence of peel injury of irradiated Temple fruit. Irradiation delayed the ripening of Zill mangoes 3 to 7 days depending on the dose (105 and 157 Krad). Irradiation alone (up to 210 Krad) and in combination with hot water dip (120°F for 7 minutes) resulted in better control of anthracnose during ripening of mangoes. Irradiation alone (216 Krad) and in combination with hot water dip (120°F for 2 and 4 minutes) reduced significantly the extent of brown rot infection of peaches. Increased decay during ripening of irradiated tomato fruit was evident. Irradiation induced softening of Temple fruit, mango, peaches, strawberries and tomatoes. However, softening during ripening of the last four products was more pronounced than that caused by irradiation. Most noticeable changes in softening of the fruit occurred immediately following irradiation with lesser changes in softening during storage of the irradiated products. Peaches irradiated at the mature-green stage exhibited increased red color development during subsequent storage at 68°F. Peaches irradiated at the firm ripe stage showed an immediate loss of anthocyanin content following irradiation. Strawberries irradiated with 300 Krad dose contained as much anthocyanin as non-irradiated fruit. Losses in reduced ascorbic acid content due to irradiation (400 Krad) of firm ripe Loring peaches were limited to about 20%. Those for Floradel tomatoes irradiated at 300 Krad were about 10%. Generally, there were no differences in pH, titratable acidity, soluble solids, AIS, and sugars of peaches, strawberries and tomatoes attributed to irradiation. Increased production of CO_2 and uptake of O_2 were found for the irradiated citrus, peaches, strawberries and tomato fruits, immediately following treatment and reaching a maximum during the first 24-48 hours. These increases were followed by gradual decline in respiratory activity approaching that of the non-irradiated fruits. Presence of 2 or more ¼" holes in film-wrapped irradiated strawberries and tomatoes prevented the accumulation of CO_2 and the depletion of O_2 from the atmosphere surrounding the packaged fruits. Floradel tomatoes ripened after irradiation with doses up to 300 Krad at 1-day or advanced stages of maturity and ripened following treatment were acceptable organoleptically as the non-irradiated fruit. Peaches ripened following irradiation at the mature green stage attained lower acceptance ratings by taste panel members. Control fruit received similar low ratings. Peaches irradiated at the firm ripe stage and further ripened to Magness-Taylor pressure test of 4 lbs were quite acceptable organoleptically. The stage of maturity at time of inoculation and irradiation of peaches influenced the amounts of sound fruit during subsequent ripening. Treatment at the mature green stage resulted in higher percentages of sound fruit than treatment at the ripe stage. A combination treatment of 200 Krad dose and heat (112°F for 20 minutes) was more effective than irradiation alone in reducing the number of viable cells of Saccharomyces cerevisiae var. ellipsoideus in orange juice. (auth)

51118 EFFECTS OF RADIATION ON FLOUR DURING STORAGE. Deschreider, A. R.; Meaux, R. Ind. Aliment. Agr. (Paris); 86: 653-9(May 1969). (In French).

Gamma rays produce important changes in the chemical and physical-chemical characteristics of flour and wheat. Most affected are the ferricyanide, Hagberg, and Pelshenke numbers. The induced changes were followed during a storage period of one year. As a rule, these properties showed an optimum value at about the ninth month of storage. The relation between this and the appearance of other phenomena induced by the irradiation is discussed. (auth)

51119 RADIOSTERILIZATION OF MEDICAL SUPPLIES. Schietecatte, W. (SCK, Mol, Belg.). J. Belge Radiol.; 53: 43-55(Jan-Feb 1970). (In Dutch).

Radiosterilization of medical and clinical material such as syringes, rubber and plastic catheters, catgut and dressings has reached the industrial stage. Research connected with applications in the field of pharmaceuticals as well as materials of biological origin is developing. The minimum required dose and the influence on physical, chemical and pharmacological properties of the products are under study. In several cases the results are very satisfactory. A survey of the most important applications is given for other fields of industrial sectors where ionizing radiations are in use. The specific aspect of sterilization by irradiation and the technical aspect of the ^{60}Co installation are discussed. (auth)

51120 EFFECT OF IONIZING RADIATION ON THE NUTRITIONAL QUALITY OF MILLED RICE DURING COOKING AND STORAGE. Sattar, A.; Tirmazi, S. A. (West Pakistan Agricultural Univ., Lyallpur). Sci. Ind. (Karachi); 6: 262-6(July 1968).

Basmati rice was irradiated by a ^{60}Co source for 18, 20, 25, 30, and 40 krads. The samples were packed in polythene bags and stored for 60 days. The control as well as the irradiated samples were analyzed chemically for moisture, nitrogen, protein, and fat contents after different storage intervals. The samples were also evaluated by the trained judges for color, texture, and aroma. It was found that there is no marked effect of irradiation and storage period on the afore-mentioned physicochemical quality characteristics of rice. (auth)

51121 TOUR OF THE PORTABLE CESIUM IRRADIATOR, PART II. Isotop. Radiat. Technol.; 8: 75-81(Fall 1970).

During 1968, the Portable Cesium Irradiator toured the western United States. The unit irradiated fresh and dried fruit, fresh vegetables, rice, potatoes, and other products in California, Arizona, and the Pacific Northwest states. The irradiator returned to Brookhaven National Laboratory in 1969 for modifications. The program was suspended because of budget restrictions. (auth)

51122 PRESERVATION OF UNCOOKED FISH MUSCLE BY CRYOGENIC RADIOSTERILIZATION. Mendelsohn, J. M. (Bureau of Commercial Fisheries Technological Lab., Gloucester, Mass.); King, F. J.; Cushman, R. W. Isotop. Radiat. Technol.; 8: 81-3(Fall 1970).

Uncooked cod fillets and clam meats were shown to retain their organoleptic acceptability after being γ-irradiated at 4.5 Mrads and at a temperature of −60°C or −190°C. (auth)

51123 RADIATION STERILIZATION OF ORANGE JUICE. Adem Ch., E.; Reyes L., J; Lopez M. del C., A. (Comision Nacional de Energia Nuclear, Mexico City). Rev. Mex. Fis.; 19: No. 1, 1-14(1970).

Juice from commercial oranges was treated with 1.0 MeV electrons and ^{60}Co γ radiation in order to study the effect of irradiation on its preservation. The analysis of organoleptic qualities, physical characteristics, and content of the main vitamins, shows several changes nonacceptable for consumption. A combined treatment of irradiation followed by a thermal shock (125 Krad, 60 and 0°C, during 2 minutes at each temperature) does not produce changes of the organoleptic qualities, color, refractive index, and absorbance. The content of the main vitamins in the treated juice is comparable with that obtained with conventional methods of preservation. This treatment, irradiation-thermal shock, offers a wide possibility of application. (auth)

51124 ORGANOLEPTIC ASSESSMENT OF IRRADIATED GRANNY SMITH APPLES FROM WESTERN AUSTRALIA. Eric, B.; Le Compte, J.; Reeve, R. F. (Australian Consolidated Industries Technical Centre, Sydney). Food Technol. Aust.; 22: 298-300(Jun 1970).

Taste, odor, texture, and consumer preference tests were carried out on West Australian Granny Smith apples. The apples were treated with 25, 50, and 100 Krads of γ radiation from a ^{60}Co source. The apples were found to be unsuited to dosages of over 25 Krad. Although 10 Krad of ionizing energy would sterilize fruit fly, it was considered that apples irradiated thus, would be unacceptable for export. Vitamin C content and preservation quality of apples were compared with unirradiated samples. No prospect for γ irradiation treatment was anticipated. (Australia)

51125 RADIOSTERILIZATION OF AN OPHTHALMIC OINTMENT CONTAINING HYDROCORTISONE AND CHLORAMPHENICOL. II. INVESTIGATION OF THE OINTMENT BASE CONSTITUENTS. Hangay, Gyoergy. Acta Pharm. Hung.; 40: 75-80 (1970). (In Hungarian).

The ointment base constituents, white soft paraffin, liquid paraffin, cetylalcohol and propleneglycol were irradiated at 2.5, 5.0 and 10.0 Mrad doses. The physical and chemical properties of the treated substances were investigated by a number of methods and the results compared with those of the untreated samples. The results were evaluated from the point of view of radiosterilizing techniques. (auth)

51126 KINETIC STUDY, DURING PRESERVATION, OF THE GLUCIDE FRACTIONS OF TWO ALFALFA ENSILAGES, AXENIC AND STANDARD. Bousset, Jean; Fatianoff, Nathalie; Gouet, Philippe (Institut National de Recherches Agronomiques, Paris). Compt. Rend., Ser. D; 270: 1174-7(23 Feb 1970). (In French).

The plant enzyme action studied in ensilages of alfalfa (Medicago sativa) sterilized by γ irradiation is nil with regard to the catabolism of the soluble glucides and the polysaccharides of the cell walls. The bacteria ferment the soluble glucides but do not attack the walls. (CEA) (France)

51127 NITROGEN AND GLUCIDE METABOLISM IN AN ALFALFA ENSILAGED STERILIZED BY γ IRRADIATION. Gouet, Philippe; Fatianoff, Nathalie; Bousset, Jean (Institut National de Recheraches Agronomiques, Paris). Compt. Rend., Ser. D; 270: 1024-7(16 Feb 1970). (In French).

Sterilization of alfalfa ensilaged by γ irradiation was used as a means to define the plant and bacterial enzyme actions as a whole. The plant proteases are determinant in the solubility of nitrogen whereas ammoniacal nitrogen is bacterial in origin. Bacteria are also responsible for the fermentation of glucides into acetic and lactic acids. Since this technique hardly modifies the substrate it will allow the behavior of the dominant bacterial species in the ensilage to be studied in situ, separately, or mixed. (CEA) (France)

51128 INDUSTRIAL DEVELOPMENT OF GAMMA RADIOSTERILIZATION. Rondenay, Francois (Conservatome, Lyon). Ind. At.; 14: No. 1-2, 34-8(1970). (In French).

Radiosterilization is one of the faster growing industrial applications of irradiation. Scientists see it as a sterilization process which is easy to control and repetitive. From the technological and economic points of view, this process is increasingly suitable for industrial use, owing to the progress achieved in developing irradiators of greater dependability and ease of operation and owing to the lower prices of radioelements. The rapid development of single purpose medical accessories stems from a reliable method of sterilization at room temperature. These are some of the factors that explain the important role now played by radiosterilization. (France)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

Refer also to abstract 50388.

51129 NBS ALLOY DATA CENTER: DESCRIPTION OF INDEX TO THE LITERATURE. Carter, G. C.; Kahan, D. J.; Bennett, L. H.; Cuthill, J. R.; Dobbyn, R. C. (National Bureau of Standards, Washington, D. C.). J. Res. Nat. Bur. Stand.; 74A: 531-3(Jul-Aug 1970).

Computerized listings of 10,000 research papers, indexed at the Alloy Data Center, are now being made available in two forms. In the first, the Permuted Materials Index, all records are arranged alphabetically by chemical symbol. Records referring to alloys or compounds are listed under each of the constituent elements. In the second, the Author Index, all papers listed alphabetically by first author in three groupings: the first, the NMR papers; the second, the soft x-ray papers; and the third, a broad group of papers that have been of general interest to the Alloy Physics Section. The magnetic tape on which the indexed file is stored will be made available at a future date. (auth)

Corrosion and Erosion

Refer also to abstracts 52895 and 52908.

51130 (AD-487718) COMPATIBILITY OF LIQUID AND VAPOR ALKALI METALS WITH CONSTRUCTION MATERIALS. Stang, J. H.; Simons, E. M.; De Mastry, J. A.; Genco, J. M. (Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center). 15 Apr 1966. Contract AF33(615)-3408. 112p. (DMIC-227). NTIS.

The interactions of liquid and vapor sodium, NaK, potassium, lithium, and cesium with solid materials of potential use in practical liquid-metal systems are examined. Data for inclusion were selected on the basis of their practical utility to designers and research workers. There has been an accelerating interest in alkali metals as coolants for fast-breeder nuclear reactors, coolants in space power plants, Rankine-cycle working fluids in high-temperature nuclear reactors, propellants in ion-propulsion engines, seeding materials in magnetohydrodynamic generators, space-charge dissipating media in thermionic generators, and high-temperature hydraulic fluids. Prominent among the liquid-metals research efforts are studies directed toward finding the best containment material for a given alkali under a given set of operating conditions. (auth) (USGRDR)

51131 (COO-2018-8) STRESS CORROSION CRACKING OF Fe-Cr-Ni ALLOYS IN CAUSTIC ENVIRONMENTS. Period Covered: July 16, 1969-October 14, 1969. (Ohio State Univ. Research Foundation, Columbus). Contract AT(11-1)-2018. 26p. Dep. CFSTI.

Stress corrosion tests have been run on commercial stainless steels in boiling 50% NaOH solutions. Resistance to cracking of wire specimens is shown to be proportional to the content of nickel plus chromium. Anodic polarization curves have been determined over a range of NaOH concentrations and for specially prepared alloys in the composition range of stainless steels. All alloys appear to persist in the passive range at room temperature although the anodic current increases as the NaOH concentration increases. (auth)

51132 (COO-2018-11) STRESS CORROSION CRACKING OF Fe-Cr-Ni ALLOYS IN CAUSTIC ENVIRONMENTS. Period Covered: October 15, 1969-January 14, 1970. (Ohio State Univ. Research Foundation, Columbus). Contract AT(11-1)-2018. 37p. Dep. CFSTI.

Results from stress corrosion and electrochemical studies are reported for Fe-Cr-Ni alloy exposed to NaOH-H_2O solutions at temperatures below 200°C. Stress corrosion studies show intergranular-transgranular transitions as the alloys and applied potentials are varied. The electrochemical studies show that increasing temperature causes the protective films to dissolve more rapidly. Also the addition of chromium to Fe-Ni appears to be deleterious to the general corrosion resistance. (auth)

51133 (WCAP-7444) PWR FLECHT INTERIM MATERIALS EVALUATION REPORT. Berlinghoff, J. H.; Mellor, J. F.; Suda, A. P. (Westinghouse Electric Corp., Pittsburgh, Pa. PWR Systems Div.). Jan 1970. Subcontract S-7045. 51p. Dep. NTIS. For Idaho Nuclear Corp., Idaho Falls.

Results of the metallographic examination of heater rods from the two early Group III PWR FLECHT tests conducted in 1969 are summarized. Information on hydrogen content, grain size, and extent of metal-water reaction is included. Also presented are the results of the materials characterization of as-fabricated Group III heater rod cladding. The peak temperatures for the two early Group III tests were 2100 and 2145°F. It was concluded that the extent of oxidation was slight, with a maximum film thickness of 0.6 mil's. The metal-water reaction is non-homogeneous with variations in oxide film formation increasing with temperature. The hydrogen uptake is relatively small and is a low fraction of "available" corrosion hydrogen. The general microstructural features (i.e., grain size) are consistent with the time-temperature history of the rods. (auth)

51134 POLARIZATION CELL FOR POTENTIOSTATIC CREVICE CORROSION TESTING. Lizlovs, E. A. (Climax Molybdenum Co. of Michigan, Ann Arbor). J. Electrochem. Soc.; 117: 1335-7(Oct 1970).

A crevice corrosion cell is described which makes it possible to obtain potentiostatic measurements with simple and easily prepared electrodes. Since the same crevice geometry is employed in every experiment, a relative resistance to crevice corrosion for a series of alloys can be deduced from comparison of polarization current-time curves at a given potential. Furthermore, the initiation and progress of the crevice attack can also be conveniently observed. Since the crevice can be applied or removed at will, many experiments which would not be possible with a fixed crevice can be performed. (auth)

51135 ANODIC BEHAVIOR OF Zn-Cd BINARY ALLOYS IN 1M SULFAMIC ACID-FORMAMIDE SOLUTIONS. Menzies, I. A.; Brodie, R. A.; Gearey, D.; Marshall, G. W. (Univ. of Manchester, Eng.). J. Electrochem. Soc.; 117: 1232-8(Oct 1970).

The anodic behavior of zinc, cadmium, and Cd-Zn binary alloys has been studied in 1M sulfamic acid-formamide solution. The anodic polarization curves for the single metals and alloys containing 90, 81.9, and 40% Cd are typical of electropolishing systems. In all cases ac impedance measurement results indicate the formation of solid anodic films at the onset of polishing. Under steady-state conditions of dissolution (300 coulombs) of the alloys, the ratios of metal dissolved anodically are similar to those in the original alloys. All current efficiencies were 100 ± 2.5%. All of the alloys are deeply etched under appropriate conditions and considerable phase contrast is found by polishing. There is a small amount of preferential dissolution of Cd-rich phases which give rise to phase contrast while film formation suppresses crystallographic etching. The effects of anode shape and method of polarization on resulting data in sulfamic acid-formamide solutions are also discussed. (auth)

51136 INTERACTION OF BERYLLIUM WITH METALS IN FUSED SALTS. Ilyushchenko, N. G.; Kornilov, N. I.; Belyaeva, G. I. Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural. Filial; No. 12, 78-84(1969). (In Russian).

Beryllium diffusion coatings applied to Ti, Nb, and alloy JS-6K surfaces in fused salts were found to protect these surfaces from high-temperature oxidation. (J.R.D.)

51137 OXYGEN INFLUENCE ON CORROSION RESISTANCE OF STEELS IN STEAM-WATER FLOWS AT 280°C. Nesmeyanova, K. A. At. Energ. (USSR); 29: 86-91(Aug 1970). (In Russian).

The influence of oxygen on the corrosion behavior of austenitic stainless and carbon perlitic steels in water, steam-water mixtures, and saturated steam flows at 280°C was investigated. It was shown that the corrosion of carbon perlitic steel in water and steam-water mixtures with oxygen was lower than the corrosion of austenitic stainless steel in the degassed mediums. The corrosion rate of both steels in the saturated steam flows was approximately the same and the oxygen did not increase the corrosion. The control tests in oxygen for a period of 5000 hr confirmed the results of the comparative tests. (auth)

51138 STUDY OF THE HIGH TEMPERATURE OXIDATION BEHAVIOUR OF STAINLESS STEEL USING TIME LAPSE PHOTOMICROGRAPHY. Fern, F. H.; Antill, J. E. (Atomic Energy Research Establishment, Harwell, Eng.). Corros. Sci.; 10: 649-55(1970).

Time lapse photomicrography was used to study the oxidation behavior of a 20% Cr-25% Ni-Nb stainless steel in CO_2 at 850°C. Various phenomena were observed. The steel is susceptible to sudden increases in oxidation rate under isothermal conditions and large oxide crystals are formed at the gas/oxide interface. The oxide spalls on cooling to leave areas with a bright metallic

appearance. On reoxidation the majority of the spalled areas behave in a passive manner indicating that a thin oxide film can remain on the steel surface and that a disproportionate degree of the protection of the steel is derived from the oxide near the oxide/metal interface. However, for some spalled areas the thin film may fail, resulting in fast local oxidation. (auth) (UK)

51139 NEW MATERIALS OF CONSTRUCTION FOR USE IN THE CHEMICAL ENGINEERING INDUSTRY. Edstroem, J. O.; Carlen, J. C.; Kampinge, S. Met. Constr. Mec.; 101: 391-9 (Aug-Sep 1969). (In French).

New steels and other alloys that are resistant to acid attack, have high mechanical strength, or are resistant to heat are described. Resistance to corrosion in highly aggressive acid and salt solutions is shown by Ti and some of its alloys and by Zr. Examples are given of the use of these materials in the paper pulp, inorganic acid (H_3PO_4, HCl, and HNO_3), fertilizer, petroleum refining, petro-chemicals, plastics, explosives, and glass industries. (Metals Abstr.)

Preparation and Fabrication

Refer also to abstracts 50507, 50509, 51197, and 51198.

51140 (NP-18457) ZONE MELTING CONDITIONS FOR SINGLE PHASE GROWTH OF INDIUM ANTIMONIDE FILMS. Report No. 6317. Williamson, W. J. (Postmaster-General's Dept., Melbourne (Australia). Research Labs.). 29 Aug 1969. 12p. Dep. CFSTI (U. S. Sales Only).

An analysis of zone melting techniques applied to the crystallization of nonstoichiometric vacuum deposited InSb thin films is presented. Initial deviations from stoichiometry <1%, growth rates <10μ/sec, and temperature gradients >100°C/sec were required. The results agreed qualitatively with previously reported work. (auth) (Australia)

51141 (ORNL-tr-2381) PREPARATION OF ALLOYS OF PLATINUM WITH BASE METALS. Bronger, W.; Klemm, W. Translated by R. G. Mansfield (Oak Ridge National Lab., Tenn.), from Z. Anorg. Allg. Chem.; 319: 58-81(1962). 23p. Dep. CFSTI.

Mixtures consisting of platinum metal powder and oxides in the powdered form of base metals were reduced by hydrogen produced from ammonia at temperatures between 900 and 1200°C to the following intermetallic phases: Pt_3Al, $Pt_{13}Al_3$, Pt_3Sc, Pt_5Y, Pt_5La; $Pt_{15}Be$, Pt_3Mg, Pt_7Mg, Pt_2Ca, Pt_7Ca_2, Pt_5Ca, Pt_2Sr, Pt_3Sr, Pt_5Sr; Pt_7Li and Pt_3Cr. The Pt_2Me alloys are known Laves phases (Cu_2Mg type). The Pt_5Me compounds crystallize in the Cu_5Ca type, with the exception of Pt_5Y; the Pt_3Me phases (Pt_3Al and Pt_3Sc being structurally elucidated) are of the Cu_3Au type, with the exception of Pt_3Sr. Regular superstructure phases exist between the phases of Pt and Pt_3Me, of which the Pt_7Me structure could be elucidated completely, the $Pt_{13}Me_3$ structure almost completely. As to the $Pt_{15}Me$ phase up to now it is only known that it has a similar structure as Pt, with a large hexagonal distorted unit cell. The transition $Pt_5Me \rightarrow Pt_2Me$ was investigated in the case of Ca alloys. Besides Pt_7Ca_2, further superstructures occur between Pt_7Ca_2 and Pt_5Ca. The volume chemistry of alloys of Pt with the elements of group I-III is discussed. (auth)

51142 EFFECT OF HAFNIUM ON THE INTERACTIONS OF ZIRCONIUM WITH CHLORIDE-FLUORIDE MELTS. Ivanovskii, L. E.; Petenev, O. S. Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural. Filial; No. 12, 66-9(1969). (In Russian).

The reactions of Zr with KCl containing more than 10% K_2ZrF_6 at 800°C were studied. Conditions were found under which the double salts of trivalent Zr are not formed because of low solubility in the melt. Methods of electrolytic separation of Zr from chloride-fluoride salts and its separation from Hf are also discussed. (J.R.D.)

51143 DIE MATERIAL CREATES NEW STANDARDS IN BRASS DIE CASTING. Braun, H. Giessereipraxis; No. 11, 179-82(2 Jun 1969). (In German).

The use of the Mo alloy TZM (0.03% C, 0.55% Ti, 0.12% Zr, 0.0025% O, 0.0005% H, 0.002% N, 0.008% Fe, 0.002% Ni) in brass die casting is described. The alloy has a melting point of 2620°C, thermal conductivity 33% of that of Cu and a thermal expansion coefficient of 4.8×10^{-6}/deg. TZM dies are hot crack resistant, permit higher pouring temperature and yield better casting surfaces. Up to 150,000 to 250,000 castings may be obtained from the same die. The die material is vacuum-arc melted and processed by extruding, rolling, forging or pressing, followed by machining. Its structure in the final condition consists of strongly elongated ferrite-like grains with finely dispersed, highly stable titanium and zirconium carbides. Mechanical properties, availability, physical properties, heat treatment, machining conditions and tool design instructions are tabulated. (Metal Abstr.)

51144 WELDING NIOBIUM TO A COPPER ALLOY BY MELTING. Strizhevskaya, L. G.; Starova, L. L.; Zhuravleva, L. B.; Moryakov, V. F.; Volkov, V. K. Svar. Proizv.; No. 12, 19-21(Dec 1969). (In Russian).

Problems arising in the welding of Nb or Nb alloys to Cu, bronze, brass, etc. are considered. As an example, the welding of a particular Nb alloy to bronze by melting is described. In order to obtain good contact and high cohesion, careful preparation of the surface is essential and a protective atmosphere is required during welding. The strength at 20 to 600°C of the welds so obtained is determined by the strength of the Cu alloy. Provided that H absorption by the Nb is prevented, the welds are quite ductile. (Metals Abstr.)

51145 BRAZING BERYLLIUM [FOR SPACE APPLICATIONS]. Weld. Design Fabr.; 42: No. 10, 74-8(Oct 1969).

The several advantages of Be as a space material are reviewed along with some of its important drawbacks. Several successful methods for joining Be are discussed. These include Zn brazing (800 to 850°F), Al-base brazing (1080 to 1250°F), Ag-Cu-base brazing (1200 to 1660°F), Ag brazing (1620 to 1750°F) and brazing of Be with dissimilar metals such as Al, Kovar (29% Ni, 17% Co, 0.5% Mn, balance Fe), stainless steel and cermets. Illustrations are given of several brazed items including Al cone frustums for atomic energy applications, Be egg-crate sandwich cores, corrugated Be sheets and a Be aircraft braking disk. (Metal Abstr.)

51146 WELDING BERYLLIUM. Weld. Design Fabr.; 42: No. 11, 94; 96; 98(Nov 1969).

Welding methods for joining Be to provide high strength and low ductility are discussed. Ductility becomes better if the weld is made with low energy input, and welds have less tendency to crack. Electron beam welding, braze welding, resistance welding and diffusion bonding are discussed. (Metals Abstr.)

51147 BRAZING AND BRAZING ALLOYS [APPLICATIONS AND TECHNIQUES]. Pattee, H. E. Mach. Design; 41: No. 21, 111-15(11 Sep 1969).

Advantages of brazing are its applicability to dissimilar metals and materials of different thicknesses in complex assemblies, the absence of induced stress and the lack of finishing required. Recommended techniques are given for brazing low-C and low alloy steel, tool steel, stainless steel, Al and Mg alloys, Cu and Ni alloys, superalloys, Ti, Zr, Be, refractory metals, precious metals, dissimilar metals and nonmetallic materials. A table lists the melting and brazing temperatures, available forms, and composition of brazing filler metals for these materials. (Metals Abstr.)

51148 PRECIOUS METALS BOOST BRAZING USES. Weld. Eng.; 55: 38-41(Jan 1970).

Palladium, Pt, and Au filler metals are resistant to high-temperature oxidation at up to 1000°F (540°C) and have free-flowing characteristics in H or vacuum brazing. Au-Cu compositions readily braze steel, stainless steel, Cu and its alloys, and Ni and its alloys. Most of their applications are for controlled-atmosphere procedures without use of a brazing flux but they are also suitable for flux brazing. Au-Cu-Ni alloys are used on difficult-to-wet metals such as W, Mo, and low-thermal-expansion alloys. Major applications are in electronic tubes with ceramic-to-metal bonds and in fuel injection manifold assemblies of jet engines. Ag-Cu eutectic compositions are used for ceramic brazing of electronic assemblies and these brazes with Pd have applications in gas-turbine, jet engine, airframe, missile, electronic and nuclear components. Pt-Ir, Pt-Au-Ag, and Pd-Ag-Ni contacts are used in voltage regulators in automobiles. (Metals Abstr.)

Properties Evaluations

Refer also to abstracts 51202, 51210, 51217, 51825, 51834, 51840, 51841, 51845, 52742, 52757, and 52915.

51149 (AD-473754) MATERIALS FOR SPACE-POWER LIQUID METALS SERVICE. Stang, John H.; Simons, Eugene M.; De Mastry, John A. (Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center). 5 Oct 1965. Contract AF33(615)-1121. 14p. (DMIC-Memo-209). NTIS.

The use of liquid metals in advanced space-power plants is examined. The principal liquid-metal candidates for such applications are mercury, NaK, potassium, lithium, cesium, and sodium. These metals are used primarily as heat-transfer media and as working fluids at high temperatures. Specific areas for

molten metal use are identified and the materials, problems, and developments associated with their containment are discussed. (auth) (USGRDR)

51150 (AI-AEC-12976) STRESS-RUPTURE BEHAVIOR OF TYPES 304 AND 316 STAINLESS STEEL CLADDING IN HIGH-TEMPERATURE STATIC SODIUM. Atkins, D. F. (Atomics International, Canoga Park, Calif.). 30 Sep 1970. Contract AT(04-3)-824. 77p. Dep. NTIS.

Stress-rupture properties of the two austenitic stainless steels, Type 304 and Type 316, were studied in a high-purity static sodium environment. Thin-walled seamless tubing, fabricated from single heats of each alloy, were tested over the range of 900 to 1400°F. This tubing was supplied with 10 to 15% cold work, and the long-term performances of the cold-worked alloys were compared with annealed material from the same heats. In addition to cold-work effects, special tests were conducted to evaluate the influence of test environment (sodium vs helium) and stress mode (uniaxial, 2:1 biaxial, and 1:1 biaxial) on the stress-rupture behavior of the two alloys. The strength benefits of cold work were found to be dependent on test temperature and degree of cold working. If the temperature was such that recovery processes occurred in the cold-worked alloy, the long-term strength was inferior to that of annealed material. Increasing the degree of cold work was found to enhance the rate of cold-work recovery. The strengthening benefits of cold work were retained longer for Type 316 alloy than for Type 304 at the same temperature. Apparently, the recovery processes are slower in Type 316 stainless steel. Cold work reduces the creep ductility of both alloys. Sodium test environment was found to reduce the amount of tertiary creep strain in both alloys. This effect was most pronounced under uniaxial stress. With a 2:1 biaxial stress, rupture occurred at the onset of tertiary creep, and the sodium effect was not apparent. Stress-rupture tests conducted on Type 304 stainless steel under three stress states (uniaxial, 2:1 biaxial, and 1:1 biaxial) have shown excellent correlation of rupture strength with von Mises' distortion theory. With Type 316 stainless steel, the von Mises correlation does not exist; instead, the rupture strength of this alloy correlates best with the maximum principal stress theory. (auth)

51151 (GEAP-10181) LOW-CYCLE, STRAIN-CONTROLLED FATIGUE CRACK PROPAGATION IN NUCLEAR PIPING STEELS. Brothers, A. J. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Jun 1970. Contract AT(04-3)-189. 102p. Dep. NTIS.

Crack growth rates under reversed tension-compression strain-controlled loading were measured for both the axial and bending mode for A-212B carbon steel, 2¼ Cr–1 Mo, and Type 304 stainless steel at room temperature. Both through-cracked, center-slotted plates and surface-cracked specimens were employed for axial loading, and a surface-cracked specimen for bending tension-compression; these latter specimens were also tested at 550°F. All results are correlated with the nominal total strain range and, where applicable, with the stress intensity factor, K. A method is proposed for correlating geometry effects for low-cycle, strain-controlled fatigue. (auth)

51152 (KFK-1166) SOLUBILITY OF INERT GASES IN SODIUM REACTOR COOLANT AND ATTENDANT SAFETY ASPECTS. Thormeier, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). May 1970. 100p. (In German). Dep. CFSTI (U. S. Sales Only).

A theoretical as well as experimental determination of the solubility of inert gases in liquid sodium is reported. The investigation covers a wide range of temperatures and pressures. A theoretical relation for Henry's coefficient can be derived from statistical thermodynamics. This is used for calculation of the solubilities of inert gases in sodium on the basis of the model concept that a dissolved gas atom requires a hole of its size in the liquid and that the gas atom, once it is placed in that hole, interacts with the ambient liquid and is made to vibrate. For experimental verification of these results a novel method has been developed for measurement of the solubility of gases in liquids which is suitable especially for determining the solubility of inert gases in liquid metals. The test facility set up allows the reliable measurement of gas concentrations in the range between $1{,}10^{-10}$ and $3{,}10^{-5}$ mole gas/mole liquid. The measured results, which are well reproducible, are in good agreement with the values derived theoretically. On the basis of the solubility data thus obtained the significance to safety of the cover gas bubbles (argon and helium, respectively) produced in the sodium as a result of temperature changes and the capacity for the fission gases krypton and xenon in sodium are regarded for the primary circuit of the fast sodium-cooled breeder reactor SNR. (auth)

51153 (KFK-1168) EXPERIMENTAL THERMAL SHOCK ANALYSIS. Lang, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). May 1970. 94p. (In German). Dep. CFSTI (U. S. Sales Only).

A method of solving problems related to transient thermal stresses is described. The method is based on the experimental determination of frequency response functions and weighting functions for thermal stresses. With the use of Duhamel's integral, it is employed to determine the time curves of the temperatures and thermal stresses generated in a structural component as a result of fast variations of the coolant temperature during reactor operation. Moreover, it provides the means to evaluate the effects of cyclic thermal loads encountered in reactor operation which may cause fatigue of the structure in long-term operation. A representative structural component of reactor technology (hollow cylinder of 100 mm inside diameter with an abrupt change of wall thickness from 20 mm to 2 mm), which is particularly sensitive to thermal stresses, was equipped with thermocouples and strain gages and investigated in a helium circuit, in order to test the proposed method. The validity of the method was demonstrated in a comparison of the results of a real thermal shock on the helium circuit with the results calculated in advance with the help of weighting functions which also had been determined experimentally. (auth)

51154 (TRG-Report-1909) EFFECT OF EXPOSURE TO SODIUM ON THE MECHANICAL PROPERTIES AND STRUCTURE OF SOME FERRITIC, AUSTENITIC, AND HIGH NICKEL ALLOYS. Thorley, A.; Longson, B.; Prescott, J. (United Kingdom Atomic Energy Authority, Risley (England). Reactor Group. United Kingdom Atomic Energy Authority, Culcheth (England). Reactor Group). 14 Jul 1969; Reprinted 1970. 47p. Dep. CFSTI (U. S. Sales Only). UK 7s.

Room temperature and high temperature tensile properties together with hardness and impact properties have been evaluated for certain ferritic and stainless alloys after exposure to flowing and semi-static sodium at temperatures typical of those expected in sodium-cooled reactor systems. The materials examined were ferritic steels containing 2¼% to 9% chromium, stainless steels of Types 321 and 316 (including FV548 and other variants) and the nickel alloy Nimonic PE. 16. The results show that the tensile properties of these materials are not altered by purely exposure to sodium provided that: the oxygen level of the sodium is less than 30 ppM; for the ferritic steels, the carbon is stabilized by appropriate additions of Ti, Nb or higher additions of chromium; and for the stainless steels and PE. 16, negligible transfer of carbon from the sodium is permitted. In the absence of stabilization, the 2¼ Cr–1 Mo ferritic steel shows a decrease in room temperature strength and an increase in ductility due to decarburization. Carburization of stainless and PE. 16 materials on the other hand lowers their room temperature ductility and to a lesser extent their high temperature ductility after prolonged periods in sodium. However, other tensile properties such as room and high temperature proof stress and UTS for most of the materials tested are relatively unaffected. The effects of carburization and decarburization on the structure of the materials are illustrated and the effect of sodium condition allied to carbon transfer in sodium is discussed. (auth)

51155 (UCRL-20308) METASTABLE AUSTENITES: DECOMPOSITION AND STRENGTH. Gerberich, W. W.; Thomas, G.; Parker, E. R.; Zackay, V. F. (California Univ., Berkeley. Lawrence Radiation Lab.). Aug 1970. Contract W-7405-eng-48. 6p. (CONF-700819-1). Dep. CFSTI.

From 2nd International Conference on the Strength of Metals and Alloys, Pacific Grove, California.

The stress-strain properties of metastable austenites, including Lüders strain and the strain hardening rate, are quantitatively predicted. This is accomplished by invoking the rule of mixtures, the relationship between the volume of strain-induced martensite, strain and austenite stability, and an empirical description of austenite stability in terms of composition and processing variables. (auth)

51156 (Y-DA-3616) COMPILATION OF THE MECHANICAL PROPERTIES OF DILUTE (5 PERCENT MAXIMUM) ALLOYS OF URANIUM. Hemperly, V. C. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). 22 Sep 1970. Contract W-7405-eng-26. 67p. Dep. CFSTI.

A data listing on U alloys compiled from technical progress reports issued by the Oak Ridge Y-12 Plant through October 1969, and from unpublished data (designated ABT) is presented. All of the data represent alloys prepared and tested at Y-12, and the compilation was prepared to facilitate surveying the available information concerning dilute (5% max) alloys of uranium. Each block of mechanical property data is followed by the available information that characterizes the test materials. The number of the technical progress report from which the information was taken follows the narrative. Because these tests were made only

to survey properties in a particular area of interest, the alloy systems have not been evaluated extensively. The headings designate the process step that was under examination at the time of testing. (auth)

51157 (ZJE-87) RESIDUAL STRESSES IN LARGE SIZE WELDED STRUCTURES. Kupka, I. (Skoda Concern, Pilsen (Czechoslovakia). Nuclear Power Plants Div.). 1970. 12p. Dep. CFSTI (U. S. Sales Only).

The principle of measurement of residual stresses on large parts of a general shape is presented. On an example quoted for the determination of residual surface as well as internal stresses, the importance of knowledge of the magnitude and distribution of stresses in large welded structures is pointed out. (auth)

51158 DETERMINATION OF THE HEATS OF DESORPTION OF IONS AND ATOMS OF POTASSIUM AND CESIUM ON THE SURFACE OF TUNGSTEN, MOLYBDENUM, AND TANTALUM. Ionov, N. I.; Lebedeva, E. N.; Marinova, Ts. S. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 39: 1323-4 (July 1969). (In Russian).

The heats of desorption were determined according to the displacement of threshold temperature of the surface ionization and temperatures in the maximum current of thermionic emission. The heats of desorption of ions at $\theta \approx 0$ in eV were: 2.3 for Cs and W, 2.1 for Cs and Mo, 2.2 for Cs and Ta, 2.1 for K and W, and 2.0 for K and Mo. The heats of desorption of atoms at $\theta \approx 0$ in eV were: 1.5 for K and W, 1.3 for K and Mo, and 1.1 for Cs and Ta. (tr-auth)

51159 OXYGEN DIFFUSION BARRIERS BETWEEN UO_2 AND Zr–Cu ALLOYS. Kaden, W.; Peehs, M. (Siemens Aktiengesellschaft, Erlangen, Ger.). J. Nucl. Mater.; 37: 18-26(Oct 1970). (In German).

It was shown that ZrCr-alloys were incompatible with UO_2 above 600°C. Particularly, oxygen diffused from the UO_2 to the ZrCu-alloy. For preventing those reactions, diffusion barriers consisting of PyC- and C-, Cu- and Ni-layers and combinations of Cu-, Cr-, and Ni-layers were investigated. Carbon was an excellent barrier material. The metallic layers—except Ni—also had a favorable barrier characteristic. PyC was deposited on UO_2, all other materials on ZrCu. The deposition methods for carbon and Cu could also be applied to the interior of tubes. In-pile-tests with the barriers are underway in the CO_2-loop of BR2. (auth)

51160 PROMETHIUM POLONIDE SYNTHESIS AND CHARACTERIZATION. Kershner, C. J.; Desando, R. J. (Mound Lab., Miamisburg, Ohio). Contract AT(33-1)-Gen-53. J. Inorg. Nucl. Chem.; 32: 2911-18(Sep 1970).

Promethium polonide was prepared by reacting ^{147}Pm metal with gaseous ^{210}Po. The compound formed was assigned the 1:1 stoichiometry on the basis of calorimetric and x-ray analyses. The compound melted at 1292 ± 25°C and possessed a Bl sodium chloride type structure with $a_0 = 6.360 \pm 0.012$ Å and a calculated density of 9.61 g/cm³. The observed melting point and structural properties of PmPo agreed with the expected values based on the trends within the series of previously studied rare earth polonides. (auth) (UK)

51161 FIELD-EVAPORATION END FORMS OF A bcc METAL SURFACE OBSERVED BY A FIELD ION MICROSCOPE. Nakamura, Shogo; Kuroda, Tsukasa (Osaka Univ.). Surface Sci.; 17: 346-58(Oct 1969).

Distinct differences in the field-evaporation end forms of W, Ta, and Mo were investigated by comparing the temperature dependence of the contribution of polarization energy and binding energy to the field-evaporation energy. The field-evaporation end form at low temperature was influenced mainly by the polarization energy of atoms under the influence of a strong field; its magnitude decreased in the following sequence: Ta, W, and Mo. As the field-evaporation temperature was raised the influence was gradually transferred from polarization energy to binding energy. Binding energies except for the {001} planes, which were estimated from the Morse potential energy, were in fair agreement with the experimental results. The field-evaporation end forms at high temperature were mainly influenced by the magnitude of the activation energy due to the self-migration of the atoms on the surface of each crystal plane. The influence of residual gases and the change of field-evaporation mechanism are discussed. (auth)

51162 EFFECT OF PRE-STRAIN ON THE HIGH TEMPERATURE DUCTILITY OF A STAINLESS STEEL. Waddington, J. S.; Evans, H. E. (Central Electricity Generating Board, Berkeley, Eng.). J. Nucl. Mater.; 37: 118-20(Oct 1970).

Increasing pre-strain at 20°C caused a continuous decrease in ductility of a 20 Cr–25 Ni–Nb stainless steel at 750°C. An almost linear relation exists between the amount of prior low-temperature strain and the steady-state stress reached at 750°C. It is postulated that the cavity growth rate is also increased by prestraining. (G.M.C.)

51163 MECHANICAL PROPERTIES AT HIGH TEMPERATURE OF THE ALLOY $UMo_{1.1}Al_{0.05}Sn_{0.05}$. Khan, Tasadduq; Brun, Gilbert; Decours, Jacques (CEN de Saclay, Gif-sur-Yvette, France). J. Nucl. Mater.; 37: 27-34(Oct 1970). (In French).

The plastic behavior in tension of the $UMo_{1.1}Al_{0.05}-Sn_{0.05}$ alloy was studied between room temperature and 630°C for deformation rates of 5.6×10^{-2}, 5.6×10^{-2}, 5.6×10^{-1}, 5.6 hr^{-1}. Slip and intergranular cracking of the γ phase were detected. These phenomena, which involved a reduction of ductility, which was greater the lower the rate of deformation, and intergranular fracture for the γ phase, were found in binary $UMo_{1.1}$ alloys and quaternary $UMo_{1.1}Al_{0.05}Sn_{0.05}$ alloys which underwent a direct $\gamma \rightarrow \alpha + \gamma$ transformation. (auth)

51164 INFLUENCE OF OXIDE STRESS ON THE BREAKAWAY OXIDATION OF ZIRCALOY-2. Bradhurst, D. H.; Heuer, P. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Nucl. Mater.; 37: 35-47(Oct 1970).

The stresses in oxide films on Zircaloy-2 and zirconium crystal bar were measured after oxidation in the temperature range 500 to 700°C. The stresses in films on Zircaloy-2 reached a maximum at an oxide thickness approximately equal to that at which breakaway oxidation occurs. The stresses in films on zirconium crystal bar remained low, and breakaway did not occur under the conditions of the experiment. The results showed that breakaway oxidation in Zircaloy-2 was probably due to the mechanical failure of a protective inner layer of oxide under the compressive stresses which arise during growth. (auth)

51165 SURFACE TENSION AND DENSITY OF SILICON–ZIRCONIUM MELTS. Elyutin, V. P.; Kostikov, V. I.; Levin, V. Ya. (Moscow Inst. of Steel and Alloys). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 2, 131-3(1970). (In Russian).

The surface tension and density of Si–Zr systems with up to 30.06% Zr were measured at temperatures from 800 to 1100°C. It was shown that Si–Zr melts with more than 25% Zr have a microhomogeneous structure. The surface properties of the melts at the gas and BN boundary were studied. (tr-auth)

51166 DECOMPOSITION KINETICS OF β-SOLUTION IN MOLYBDENUM–TITANIUM ALLOYS. Kasparova, O. V.; Polkin, I. S. (Moscow Inst. of Steel and Alloys. All-Union Inst. of Light Alloys, Moscow). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 2, 120-5(1970). (In Russian).

The mechanical properties and decomposition kinetics of beta-solution in Ti alloys with 15, 20, and 25% Mo were studied by metallographic, dilatometric, and x-ray phase analyses after quench hardening from beta-phase and aging at 400 to 550°C. It was shown that an increase of Mo content in the alloy slowed down the decomposition of beta-solution, and a decreased tendency of the alloy to hardening was observed. Also, an increase in the amount of Mo in the alloy increased the heterogeneity of solid solution decomposition. (tr-auth)

51167 STAINLESS TUBING FOR FEEDWATER HEATERS. Kopecki, E. S. Power Eng.; 74: No. 9, 46-7(Sep 1970).

The large-scale use of stainless steel tubing in feedwater heaters is examined. Factors contributing to the rapid growth of stainless steel use in heat exchangers include economic competiveness, corrosion and erosion resistance, and cleanliness and hardness of surfaces. Data on quantities of stainless steel now used are included. (J.R.D.)

51168 DIRECT HEATING METHODS FOR MEASURING THERMAL CONDUCTIVITY OF SOLIDS AT HIGH TEMPERATURES. Taylor, R. E.; Davis, F. E.; Powell, R. W. (Purdue Univ., West Lafayette, Ind.). High Temp. - High Pressures; 1: 663-73(1969).

The degree of scatter in the high-temperature thermal conductivity determinations for a pure metal is exemplified by the results available for tungsten. A survey is also presented of the many variants of the direct electrical heating methods that have been employed for determinations of this property. These heated-rod methods are divided into categories according to whether two, one or no integrations were used in the derivation of the working equation. Previous mathematical integrations have required the introduction of various assumptions and restrictive conditions. An experimental apparatus and procedure are described, together with methods for the evaluation of the thermal conductivity from temperature-profile observations made on electrically heated rods, which avoid any such restrictive assumptions. Details are given of computer evaluations using both 3-point and spline methods. Typical results for the thermal conductivity and electrical resistivity for ATJS graphite to nearly 2400°K are included. Also in-

cluded is a new least squares curve for tungsten from 1700 to 2800°K which lies about 4% below the TPRC (Thermo Physical Properties Research Center) recommended curve of 1966, and lies between the results of other recent measurements on tungsten from the same stock. (auth) (UK)

51169 EFFECTS OF TEMPERATURE ON RESISTANCE TO DEFORMATION OF NICKEL–MOLYBDENUM AND NICKEL–TUNGSTEN ALLOYS. Sukhovarov, V. F.; Karavaeva, V. V.; Kharlova, R. P. (Siberian Physical-Technical Inst., Tomsk, USSR. Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 89-93(1970). (In Russian).

The effects of temperature on the tensile properties, of Ni alloys with 5 and 10 at. % Mo and with 5 at. % W were studied. Kinetic curves of electrical resistance changes during tempering at 400°C and ductility at various temperatures were analyzed. It was postulated that abnormalities in the strain rate-vs-temperature curves were caused by dislocations in the Kottrell carbon atmosphere and formation of microcarbides during the deformation process. It was shown that the K-phase magnifies the peaks on the flow curves. (tr-auth)

51170 DIFFUSION OF ZINC IN PRASEODYMIUM. Dariel, M. P. (Nuclear Research Centre-Negev, Beer-Sheva, Israel). Phil. Mag.; 22: 563-71(Sep 1970).

The thin-layer lathe-sectioning technique has been used to measure the solute diffusivities of zinc in bcc and double-hcp praseodymium. The diffusivities in the bcc phase can be expressed by $D = 6.3 \times 10^{-1} \exp(-27{,}000/RT)$ cm²/sec, and in the double-hcp phase by $D = 1.8 \times 10^{-1} \exp(-24{,}800/RT)$ cm²/sec. The diffusion behavior of zinc is similar to that of previously studied noble metal solutes. These solutes are believed to diffuse by means of the combined substitutional–interstitial diffusion mechanism. It is therefore suggested that zinc is partly dissolved as interstitials in the praseodymium matrix. (auth) (UK)

51171 CHANGE OF MECHANICAL PROPERTY WITH AGING IN Fe-13 AT. PERCENT Be ALLOY. Yamagata, Toshihiro; Yagisawa, Kobei; Yoshida, Hidehiko (National Research Inst. for Metals, Tokyo). Trans. Iron Steel Inst. Jap.; 10: 264-9(Jul 1970).

The change in mechanical properties of an Fe-13 at.% Be alloy with aging was investigated by compression testing at room temperature. The 0.2% flow stress as a function of time of aging below 600°C consisted of a steep hardening stage and a slow hardening stage. In the former stage specimens were deformed by twinning, while in the latter by slip. With the increase of aging temperature, the stress at which the deformation mode changed from twinning to slip rapidly decreased and the transition point of the mode moved to the earlier period of aging. A remarkable increase in twinning stress was found to be associated with the decrease in the twin thickness; for example, in an as-quenched specimen the twinning stress was 35 kg/mm² and the twin thickness was about 2 μ, whereas in a specimen aged at 300°C for 1000 hr the former increased to 210 kg/mm², and the latter decreased to about 600 Å. In specimens aged at 650 and 700°C, large particles precipitated and twinning stress increased only slightly. It was suggested that the presence of fine precipitates in specimens aged below 600°C caused not only the increase of the twinning stress but also the decrease of the twin thickness. (auth) (Japan)

51172 SOLDERING AND SOLDERING ALLOYS [CHARACTERISTICS AND COMPOSITIONS]. Smith, Jerome F.; Borcina, David M. Mach. Design; 41: No. 21, 116-18(11 Sep 1969).

Mechanical properties, wettability, and other characteristics are given for solders of Sn–Pb, Sn–Pb–Sb, Sn–Sb, Sn–Ag, Sn–Zn, Pb–Ag, Cd–Zn, Zn–Al, In and fusible alloys. Tables list compositions of solder alloys, the solderability of Al alloys and flux requirements for soldering Al, Al bronze, Be, beryllium copper, brass, Cu and its alloys, Au, Ni alloys, Pt, Ag, stainless steel, Sn, Ti and Zn. (Metals Abstr.)

51173 NICHROME WITH DISPERSED OXIDE IMPURITIES. Antsiferov, V. N.; Karpova, G. P.; Polyakov, V. A.; Tomilova, L. A. (Perm Polytechnic Inst., USSR). Metalloved. Term. Obrab. Metal.; No. 6, 52-4(1970). (In Russian).

It was shown that dispersed impurities of oxides, Al_2O_3 or ZrO_2, in Nichrome increases its high temperature strength and contributes to the process of recrystallization. Also Nichrome containing dispersed Zr oxide additions possessed high strength characteristics at elevated temperatures. Nichrome with 3% ZrO_2 exhibited high strength characteristics at 950°C. (tr-auth)

51174 MEASUREMENT OF DENSITIES OF THIN FILMS OF LEAD AND INDIUM. Bhatnagar, Anil K. (St. John's Univ., Jamaica, N. Y.). J. Appl. Phys.; 41: 5023-4(Nov 1970).

Errors in previous measurements of density in extremely thin films (<1000 Å) were avoided by depositing films on similar substrates, using liquid-nitrogen-cooled substrates, and using a polarographic technique to measure the film mass. A plot of polarographic thickness (mg/cm²) vs interferometric geometrical thickness resulted in straight lines, and the films were electrically continuous in the range of 200 to 2700 Å. The results show that the densities of Pb films thicker than 300Å and In films thicker than 500 Å are independent of thickness and equal to the bulk value within experimental accuracy. (D.L.C.)

Structure and Phase Studies

Refer also to abstract 51816.

51175 (ANL-Trans-856) PHASE DIAGRAMS OF THE SYSTEM URANIUM–OXYGEN–CARBON. Knacke, Ottmar; Krahe, Josef; Muller, Franz. Translated for Argonne National Lab., Ill., from Z. Metallk.; 58: 814-20(1967). 19p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 11083.

51176 THE BRITTLE-DUCTILE TRANSITION OF CUBIC-SPACE-CENTERED METALS TAKING TUNGSTEN AND MOLYBDENUM INTO SPECIAL CONSIDERATION. PART I. EXPERIMENTALS. Pink, E.; Sedlatschek, K. (Metallwerk Plansee AG, Reutte/Tirol, Austria). Metall; 23: 1249-57(Dec 1969). (In German).

For the determination of the brittle-ductile transition of W and Mb sheets, bending tests at different temperatures were selected as the most suitable method. The results were altered when important dimensions of the apparatus were varied. The best indication of the transition was obtained when the narrowest possible support spacing was used. The ratio of the piston radius to the sample thickness (T value) is significant for the transition temperature. Proposals for the standardization of the behavior were derived from the results. The transition temperatures for roll-hardened Mo and W are –80 to –70°C and 100 to 200°C, respectively; for the recrystalized metals they are 20 to 100°C and about 360°C. Recrystallized Mo and W with marked pile structure are still ductile at room temperature. The change of the transition temperature in the Mo–W is not linear. An increase of the transition temperature of recrystallized material was caused by the substitution effect, however, a decrease was evident in the roll-hardened specimens such as dispersions of Mo Al_2O_3. Large masses of the dispersions (>1 vol %) cause embrittlement. An improvement of the surface state by mechanical or electrochemical polishing or a leveling by oxidation leads to greater ductility. Metallographic studies on recrystallized samples show intercrystalline fractures at stresses below the transition temperature and over the transition temperature with transcrystallized samples. Samples with deformation structure break also when transcrystallized in the brittle region. In a fiber structure, the crack when it occurs intercrystalline must pass through a greater break path, since the grains are indented into each other. In this case the energy spent seems to be lowest in the transcrystallized fracture. In a research series with recrystallized non-say Mo, the effect of the grain form on the site of the transition temperature was studied. At a given ratio of grain length to grain width, no additional decrease of the transition temperature is to be expected on grain form alone. The effect of the grain size in recrystallized material is not clear: a gross grain produced by high temperature annealing impairs the ductility, whereas a grain produced by critical deformation and subsequent recrystallization causes an improvement. An improvement of the ductility is also possible by high temperature quenching in which a high content of impurities is dissolved. For recrystallized Mo the Petch parameter important for the Cottrell fracture condition was obtained by evaluation of the stress-expansion diagrams. The temperature dependence of α_1 was established. It confirms the insensitivity of k_y to changes of the research temperature. (tr-auth)

51177 STUDY OF Zr–Cu SYSTEMS: THERMODYNAMICS BY ELECTROMOTIVE FORCE. Novokreshchenov, Yu. V.; Ilyushchenko, N. G.; Rossokhin, B. G.; Nichkov, I. F. Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural. Filial; No. 12, 70-7(1969). (In Russian).

The electromotive forces of pure Zr and Zr–Cu alloys from 0.6 to 80 wt % Zr were measured in galvanic cells containing melts of NaCl–KCl to which 4 wt % K_2ZrF_6 and 2 wt % KF were added. Phases identified at 960 to 1130°K included $ZrCu_4$, Zr_2Cu_3, Zr_7Cu_{10}, ZrCu, and Zr_2Cu. (J.R.D.)

51178 INVESTIGATIONS OF Sm–Co AND Gd–Co SYSTEMS. Lihl, F.; Ehold, J. R.; Kirchmayr, H. R.; Wolf, H. D. (Technische Hochschule, Vienna). Acta Phys. Austr.; 30: 164-75 (1969). (In German).

On the basis of roentgenographic, differential thermal analysis, and metallographic investigations, the phase diagram of the Gd–Co system in the total concentration range and the phase diagram of the Sm–Co system between 60 and 100 at. % Co were investigated. Nine intermetallic compounds were found in the Gd–Co system; GdCo was metastable. The structure types and lattice constants of Gd_2Co_{17}, $GdCo_5$, Gd_2Co_7, $GdCo_3$, $GdCo_2$, Gd_4Co_3, and Cd_3Co were determined. The structures of two compounds with the approximate composition Gd_9Co or Gd_7Co_3 were not elucidated. In the system Sm–Co, in the region 60 to 100 at. % Co, the intermetallic compounds Sm_2Co_{17}, $SmCo_5$, Sm_2Co_7, $SmCo_3$, and $SmCo_2$ as well as their structures and lattice constants were determined. (tr-auth)

51179 PHASE EQUILIBRIUMS IN THE SYSTEMS Ni–Nb–Mo, Ni–Nb, AND Ni–Mo. Wicker, Alain; Allibert, Colette; Driole, Jean; Bonnier, Etienne (Ecole Nationale Superieure d'Electrochimie et d'Electrometallurgie, Grenoble, France). Compt. Rend., Ser. C; 271: 273-5(27 Jul 1970). (In French).

The precipitation of Nb–Mo solid solutions in a liquid metal matrix was studied. The isothermal section of the ternary system Ni–Nb–Mo was plotted at 1400°C and the binary diagrams Ni–Nb and Ni–Mo were studied between 1200 and 2100°C. (auth) (France)

51180 KINETICS OF PARTICLE GROWTH IN GAMMA-PHASE OF CHROMIUM–MOLYBDENUM–NICKEL–TUNGSTEN ALLOYS WITH VARIOUS ALUMINUM/TITANIUM RATIOS. Sorokina, Yu. G.; Yuganova, S. A. Metalloved. Term. Obrab. Metal.; No. 3, 8-12(1970). (In Russian).

Experimental studies of the kinetics of particle growth in Al–Cr–Mo–Ni–Ti–W alloys during prolonged aging were performed. The data obtained were compared with previously obtained data for similar alloys which did not contain Mo and W, and the effects of these elements on particle coagulation during the strengthening phase were determined. (tr-auth)

51181 FORMATION OF DISLOCATION LOOPS IN GADOLINIUM. Srivastava, M. M.; Srivastava, O. N. (Banaras Hindu Univ., India). Curr. Sci. (India); 39: 461-2(20 Oct 1970).

Electron-microscopic observations were made of the formation of dislocation loops in basal-oriented thin single-crystal-film hcp Gd. It is argued that the loops are formed by the interaction between vacancies and dislocations. (D.L.C.)

Radiation Effects

Refer also to abstracts 51784, 52809, and 52916.

51182 (CEA-CONF-1619) LENGTH VARIATIONS OF THE α, β, AND δ PHASES OF PLUTONIUM DUE TO SELF-IRRADIATION AT 1.4 AND 4.2°K. Jacquemin, Jean; Lallement, Robert (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1970. 11p. (In French). (CONF-701001-8). Dep. CFSTI (U. S. Sales Only).

From 4th International Conference on Plutonium and Other Actinides, Santa Fe, N. Mex.

The variations in length and those of the crystal parameter of α plutonium do not lead to the same volume variation value. In addition the laws governing length variation with irradiation time are different from those observed for the resistivity variation. Results of two series of experiments aimed at explaining these phenomena are presented. Very pure plutonium was used for the first experiment (200 to 300 ppM impurities) and less pure plutonium for the second (800 ppM impurities), the length variations being measured by means of stress gages. The first experiment showed up the mobility of certain defects (interstitials) in the alpha plutonium lattice at temperatures below 4.2°K. The length variations observed at 1.2°K are large. The second experiment showed a contraction of the α and β phases under the effect of self irradiation at 4.2°K. This irradiation induced densification is associated with the intrinsic properties of point defects in the crystal lattice of the β, δ, and probably ϵ phases of plutonium. (auth) (France)

51183 (CEA-CONF-1621) INFLUENCE OF DEFECTS CREATED BY NEUTRON IRRADIATION AT 80°K ON THE ELASTIC MODULI AND INTERNAL FRICTION OF MAGNESIUM. Hillairet, Jacques; Bonjour, Emmanuel (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Poirier, Jean-Paul (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1970. 26p. (In French). (CONF-700624-1). Dep. CFSTI (U. S. Sales Only).

From Conference on Anelastic Effects due to Defects and Phase Transformations in Solids, Lausanne, Switzerland.

Defects caused by irradiation at 80°K in two grades of magnesium (99.95% and 99.997%), after annealing at 450°C, lead to an appreciable reduction of the internal friction and elastic moduli. For high neutron doses, the decrease is about 4% for the Young's modulus and reaches 7% for the shear modulus. The magnitude of the modulus variation observed in magnesium cannot be explained either by a possible anelastic effect or by conventional models of the elastic effect in volume. It may be due to a large local change in the elastic constants, or to apparent modulus effects. The annealing of radioinduced defects is studied in the temperature ranges associated with stage III (90 to 170°K) and with a recovery above room temperature. (auth) (France)

51184 (CONF-700819-3) EFFECT OF NEUTRON DAMAGE ON THE DISLOCATION DYNAMICS OF BCC METALS AND SOLID SOLUTIONS AT LOW TEMPERATURES. Arsenault, R. J.; Pink, E. (Maryland Univ., College Park). 1970. Contract AT(40-1)-3612. 13p. Dep. NTIS.

From 2nd International Conference on the Strength of Metals and Alloys, Pacific Grove, Calif.

Single crystals and polycrystalline samples of V, V–Ti, and Mo with various interstitial impurity levels were irradiated with 10^{19} to 10^{20} fast n/cm^2. The yield and flow stress were measured at various temperatures and strain rates, and slip parameters were also determined. The irradiation effects on the thermal component τ^* of the flow stress is found to be influenced by the amount of impurity interstitials; no change results from a high interstitial concentration. For intermediate interstitial ranges (100 to 300 ppM), a reduction in τ^* can result due to interstitial trapping by the radioinduced defects, but for this to occur, the interstitials have to be the rate-controlling barrier to dislocation motion. For low interstitial concentration, τ^* is increased in those bcc metals with a low activation energy of deformation. Alloying additions obscure these effects. (D.L.C.)

51185 DESORPTION OF IONS AND NEUTRAL MOLECULES FROM GASES ADSORBED ON TUNGSTEN SURFACES BY MEANS OF SLOW ELECTRONS. Ageev, V. N.; Kutsenko, E. N. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 39: 1275-83(July 1969). (In Russian).

A method based on the use of a pulse mass spectrometer was worked out for studying the charged and neutral components of desorption by slow electrons. When tungsten ribbons were bombarded by electrons, the desorption of H^+ ions from adsorbed hydrogen and O^+ ions from adsorbed CO and O_2 was observed. The dependence of H^+ and O^+ ion currents on the temperature of the adsorbent was determined. It was shown that O^+ ions leave the surface with greater initial velocity than H^+ ions. The desorption of neutral molecules of H_2, CO, and CO_2 was observed. The cross sections for desorption of CO_2 by electron impact were determined. (tr-auth)

51186 MICROSTRUCTURE OF HIGH-TEMPERATURE NEUTRON-IRRADIATED TANTALUM AND MOLYBDENUM. Kulcinski, G. L.; Mastel, B. (Battelle Memorial Inst., Richland, Wash.). J. Appl. Phys.; 41: 4752-3(Oct 1970).

Pure Ta and Mo foils were irradiated in EBR-II at 450°C by a flux of 3×10^{21} n/cm^2 (E > 0.1 MeV). After a 6-month decay, samples punched from the foils were thinned by jetting with an electrolyte and examined by transmission electron microscopy. The Ta microstructure showed a large density (10^{15}/cm^3) of small loops and defect clusters; the average size was 50 Å. The damage in Ta was similar to that in Mo except for the large clusters present in the latter. No voids larger than 50 Å in diameter were found. (D.L.C.)

51187 OBSERVATION OF LARGE FAULTED INTERSTITIAL LOOPS IN PROTON-IRRADIATED NICKEL. Mazey, D. J.; Hudson, J. A. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater.; 37: 13-17(Oct 1970).

Large single and double-faulted dislocation loops were observed together with voids in nickel irradiated with 4 MeV protons at 450°C. Analysis of the single faulted loops showed them to be extrinsic Frank loops with Burgers vectors $\frac{1}{3}\langle 111\rangle$, lying on $\{111\}$ planes. (auth)

51188 MECHANISMS OF IRRADIATION CREEP IN ZIRCONIUM-BASE ALLOYS. Nichols, F. A. (Bettis Atomic Power Lab., West Mifflin, Pa.). Contract AT(11-1)-GEN-14. J. Nucl. Mater.; 37: 59-70(Oct 1970).

A multiple-mechanism explanation was presented previously to explain the creep rates of zirconium–base alloys under neutron irradiation. This interpretation involved defect loop alignment at low stresses, radiation-enhanced climb over radiation obstacles at intermediate stresses and cutting of obstacles at high stresses. Other authors have made alternative proposals. Recent data on stress-dependencies, obtained principally in the intermediate stress region, are shown to offer support for the multiple-mechanism scheme and counter-arguments are presented concerning the differing interpretations. (auth)

51189 DEPENDENCE OF THE TENSILE PROPERTIES OF IRRADIATED ALUMINUM–LITHIUM ALLOYS UPON GAS BUBBLE SIZE AND DISTRIBUTION. Smith, I. O.; Russell, B. (Univ. of Queensland, St. Lucia, Australia). J. Nucl. Mater.; 37: 96-108(Oct 1970).

The effect of inert gas bubbles on the tensile properties of neutron irradiated aluminum–lithium alloys was examined in the temperature range 105 to 523°K. An analysis of the macroyield strength of alloys containing various size distributions of gas bubbles at 223°K showed that bubbles were weak obstacles to dislocation movement with breaking angles which varied from 132° for 150 Å diameter bubbles to 144° for 50 Å bubbles. Below 50 Å diameter the breaking angle decreased rapidly and became 174° for bubbles approximately 15 Å in diameter. The temperature dependence of the macro-yield stress for alloys irradiated to thermal neutron doses of 1.2×10^{19} nvt and less showed that the presence of small bubbles caused an additional friction stress. Higher irradiation doses produced dislocation locking, possibly due to the formation of jogs on glide dislocations. Ductility was severely reduced at high temperatures by the presence of inert gas bubbles in the grain boundaries. The ductility of irradiated material at low temperatures increased significantly and material which contained bubbles became more ductile than the unirradiated alloy. During post-irradiation annealing, which resulted in the coarsening of an originally fine distribution of small bubbles, the macro-yield stress increased to a maximum value and then decreased. (auth)

51190 USE OF ION ACCELERATORS TO SIMULATE FAST NEUTRON-INDUCED VOIDAGE IN METALS. Nelson, R. S.; Mazey, D. J.; Hudson, J. A. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater.; 37: 1-12(Oct 1970).

The basic concepts underlying the use of ion accelerators to simulate fast neutron-induced voidage in metals are discussed in detail. The choice of ion species and energy, and consequently the type of accelerator, depends primarily on the ability to produce sufficient damage at an adequate depth in a reasonable time. The factors influencing this choice for particular cases are discussed at length. Furthermore, the special experimental techniques developed for such neutron damage simulation experiments are outlined. A selection of results showing void formation in Ni and 316 steel induced during ion bombardment were chosen to illustrate the usefulness of such experiments. Finally, the results of an experiment designed to calibrate the damage-depth dependence for a typical 20 MeV C^{++} ion bombardment of Ni are given, together with an estimate of the equivalent total neutron dose. (auth)

Ceramics and Cermets

Refer also to abstracts 50388 and 50439.

Corrosion and Erosion

51191 (DP-Report-332) CATALYTIC INFLUENCE OF DIFFERENT METALS ON CORROSION RATE OF GRAPHITE. Project DRAGON. Pointud, M. L.; Karcher, W.; Pollitt, N.; Lothe, J. (Atomic Energy Establishment, Winfrith (England)). Apr 1965. 62p. (CONF-641031-8). Dep. NTIS.

From Symposium on Basic Research, Harwell, Eng.

A summary of the work carried out on the catalysis by different metals of the corrosion of graphite in presence of water vapor, carbon dioxide, or oxygen is presented. (auth)

Preparation and Fabrication

Refer also to abstracts 50507 and 51147.

51192 (DP-Report-379) THE DEVELOPMENT OF THE 'UC-10' TYPE FUEL KERNELS FOR THE SECOND CHARGE OF THE DRAGON REACTOR EXPERIMENT. Burnett, R. C.; Horsley, G. W.; Mayr, K. (Atomic Energy Establishment, Winfrith (England)). Sep 1965. 22p. Dep. CFSTI (U. S. Sales Only).

The development of a method of producing spheroidal fuel kernels consisting of a dispersion of uranium dicarbide particles in a carbon matrix is summarized. The preparation of green kernels from furfuryl alcohol bonded urania/carbon mixtures by a planetary mill technique is described along with hardening of the kernels, heat treatment of the fuel kernels, and the production of kg quantities of fuel for use in the Dragon Reactor. (auth)

51193 (DP-Report-381) CONSOLIDATION OF PYROLYTIC-CARBON CARBIDE FUEL PARTICLES IN A GRAPHITE MATRIX. PART II. Project DRAGON. Williams, G. H.; Morris, J. B.; Savage, D. W. (Atomic Energy Research Establishment, Harwell (England)). Oct 1965. 57p. (AERE-R-4642). Dep. CFSTI (U. S. Sales Only).

The effects of various processing conditions on the degree of particle dispersion and the extent of particle breakage in hot-pressed compacts of coated particles in a pitch-bonded graphite matrix were studied. A new mixing method was developed known as overcoating, which yielded a random distribution, whereas the conventional methods, known as solvent and tumble mixing, gave an excessive degree of particle clustering for compacts containing 30 vol % of coated particles. Small changes in particle size and density had no effect on the overall dispersion. The short-range dispersion, as measured by counting the number of neighbors within a fixed distance, was found to be the best criterion for studying the quality of compacts with regard to particle distribution. On this basis an overcoated mix yielded the best compacts. (auth)

51194 CARBURATION RATE OF UO_2 MICROSPHERES. Olivi, A. (CAMEN, Pisa, Italy). Energ. Nucl. (Milan); 16: 725-6(Nov 1969). (In Italian).

The conversion of microspheres of UO_2 into UC_2 was studied as a function of the reaction time at different temperatures and for different sphere radii. The comparison of the experimental and calculated data concerning the dependence of the kinetic constant K on the dimensions of the UO_2 microspheres indicates that a kinetic model in which the rate of the process depends only on the diffusive resistance of the product layer is not satisfactory. (J.S.R.)

51195 PREPARATION OF PuO_2 CRYSTALS BY THERMAL DECOMPOSITION OF $Pu(SO_4)_2$ DISSOLVED IN CHLORIDE MELTS. Schlechter, M. (European Inst. for Transuranium Elements, Karlsruhe, Ger.). J. Nucl. Mater.; 37: 82-8(Oct 1970).

The growth of PuO_2 crystals by thermal decomposition of $Pu(SO_4)_2$ dissolved in KCl–$PbCl_2$ or in LiCl–KCl solution was studied. Crystal growth from the bulk of the fluxed melt was obtained. Besides, vapor-phase growth of PuO_2 was observed. The crystals were characterized by x-ray diffraction. Using the KCl–$PbCl_2$ flux, PuO_2 single crystals with an overall size of 1 mm were obtained. The oxide product made using the LiCl–KCl flux contained crystals with cube and platelike growth habits. (auth)

51196 EFFECTS OF PARTICLE SIZE, REACTION ATMOSPHERE, AND Fe_2O_3 ADDITIONS ON ZrO_2 STABILIZATION BY Y_2O_3. Glumov, M. V.; Neuimin, A. D.; Pal'guev, S. F.; Strekalovskii, V. N. Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural. Filial; No. 12, 130-4(1969). (In Russian).

These parameters were investigated using mixtures of ZrO_2 and Y_2O_3 to prepare cubic solid solutions. The preparation process involved mechanical mixing and calcination at 1500 to 1600°C followed by sintering. It was found that the product quality was largely dependent on the properties of the ZrO_2 starting material. (J.R.D.)

51197 PRODUCTION OF C.E.R.C.A. FUEL ELEMENTS. Pollet, M. (CERCA, Paris). Energ. Nucl. (Paris); 12: 327-30(Jul-Aug 1970). (In French).

The Compagnie pour l'Etude et la Réalisation de Combustibles (C.E.R.C.A.) supplies fuel elements for all types of nuclear reactors. The colaminated element production is due to the development of special sintered fuels. The production of Westinghouse-type PWR fuel elements, for which the company has exclusive license in France, is described. (auth) (France)

51198 SOCIETE INDUSTRIELLE DE COMBUSTIBLE NUCLEAIRE (S.I.C.N.). Saulnier, A. (SICN, Paris). Energ. Nucl. (Paris); 12: 323-6(Jul-Aug 1970). (In French).

More than 8500 tons of fuel elements have been delivered over the last fifteen years by the S.I.C.N. Co. Some recent technical improvements, especially in the development of a continuous vacuum-casting process for uranium, reduced the production costs of the uranium fuel elements. As far as ceramic fuels are concerned S.I.C.N. cooperates with C.E.A. in the development of fuel elements for the fast reactors, Rapsodie and Phenix. S.I.C.N. will supply fuel elements to EDF for its future light water reactors. (auth) (France)

51199 DESIGN OF A CONTINUOUS MANUFACTURING PROCESS FOR PRODUCING MIXED $(U,Pu)O_2$ FUEL PELLETS FOR FAST NEUTRON REACTORS. Teboul, Albert (CICAF, Bollene, France). Energ. Nucl. (Paris); 12: 331-5(Jul-Aug 1970). (In French).

Furnaces operating continuously for the production of calcinated plutonium oxalate with a production capacity of approximately 30 Kg/day of plutonium oxide and presintering–sintering furnaces

with a production of 1.5 tons per month of sintered pellets with highly reproducible characteristics (density, geometrical specifications) are discussed. The furnace is equipped with a lockchamber for loading and unloading in a glove box. The laboratory has a presintering area to eliminate the binders and a sintering area where temperatures of 1700°C can be obtained. The parts to be sintered are placed in a molybdenum protective cup. (auth) (France)

51200 EFFECT OF STOICHIOMETRIC DISTURBANCE OF THE COMPOSITION ON THE SINTERING OF ZIRCONIUM DIOXIDE IN VACUUM. Andreeva, N. A.; Kozlovskii, L. V. (Technological Inst., Leningrad). Ogneupory; No. 2, 55-8(Feb 1970). (In Russian).

The effect of ZrO_{2-x} additions on the sintering of ZrO_2 in a vacuum was studied. It was shown that additions of ZrO_{2-x} intensified the sintering of ZrO_2 in the range of pressures and temperatures in which ZrO_{2-x} is stable. At lower temperatures and greater residual pressure, the addition of ZrO_{2-x} slowed down the densification process due to the increased O diffusion in ZrO_{2-x}. (tr-auth)

51201 EFFECT OF GAS MEDIUM ON ZIRCONIUM DIOXIDE REACTION WITH CERIUM DIOXIDE AND PROPERTIES OF THE SINTERED MATERIAL. Klyucharov, Ya. V.; Strakhov, V. I. (Technological Inst., Leningrad). Ogneupory; No. 1, 40-6(Jan 1970). (In Russian).

A partial reduction to metal was observed in CeO_2 placed in a vacuum and in a reduction medium. Combined stabilization and sintering of $ZrO_2-Ce_2O_3$ produced poor results. Dense and stable products of $ZrO_2-Ce_2O_3$ can be obtained from a preliminary synthesized solid solution of Zr_2-CeO_2. (tr-auth)

51202 CARBURIZATION OF MOLYBDENUM IN GLOW-DISCHARGE PLASMA. Kuznetsov, G. D.; Babad-Zakhryapin, A. A.; Lagutkin, M. I. Metalloved. Term. Obrab. Metal.; No. 6, 10-12(1970). (In Russian).

The process of carburization in glow-discharge plasmas was studied considering the formation of a pyrocarbon layer on the treated surface. The treatment was conducted in an abnormal glow-discharge at discharge temperatures from 1300 to 1900°C, at a pressure of 20 mm Hg, and a methane consumption of 6 l/hr. Plasma discharge interaction with Mo formed a diffusion layer on the surface composed of hexagonal carbide Mo_2C, and, in certain cases, also the hexagonal carbide of MoC. (R.V.J.)

Properties Evaluations

Refer also to abstracts 51159, 51168, 51786, 51842, and 51846.

51203 (CEA-CONF-1505) ABSORPTION OF ^4He BY ACTIVATED CARBON. Roubeau, P.; Der Nigohossian, G.; Avenel, O. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 7p. (In French). (CONF-691210-1). Dep. CFSTI (U. S. Sales Only).

From International Conference on Vacuum and Cold, Grenoble, France.

The adsorption of helium-4 on activated carbon was studied between 2 and 80°K at equilibrium pressures from 10^{-9} to 10^3 mm Hg in order to determine the adsorption parameters more precisely. The results obtained are shown graphically. The uncertainty reaches or exceeds 10% only at pressures below 10^{-5} mm Hg, temperatures below 2.5°K, or adsorbed quantities less than 0.01 cm^3/gm or in the region where the dead volume correction reaches 10% (temperatures above 60°K). (J.S.R.)

51204 (CEA-CONF-1588) THERMODYNAMIC PROPERTIES OF PLUTONIUM CARBIDES. Marcon, Jean Pierre; Poitreau, Jean; Roullet, Gilbert (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1970. 11p. (In French). (CONF-701001-7). Dep. CFSTI (U. S. Sales Only).

From 4th International Conference on Plutonium and Other Actinides, Santa Fe, N. Mex.

Various experimental methods were investigated in order to determine the free energies of formation of plutonium carbides: vapor pressure measurements were made and the results interpreted from Pu-C diagram data. The importance of the oxygen as an impurity, was emphasized; carbon monoxide pressure measurements at equilibrium were made above the domain $Pu_2O_3-Pu_2C_3-C$ and the value obtained for $PuC_{1.5}$ was $\Delta G_f^\circ = 25,870 - 1.57\ T$; calorimetric measurements required the determination of the heat of formation at room temperature (for $PuC_{0.5}$, ΔH_{298}^f = 12 kcal and for $PuC_{1.5}$, $\Delta H_{298}^f = -24.4$ kcal) and that of the variation of specific heat with temperature. (auth) (France)

51205 (CEA-CONF-1620) MECHANICAL PROPERTIES OF CERAMICS CONTAINING URANIUM AND PLUTONIUM. de Novion, Charles-Henri; Amice, Bernard; Groff, Alain; Guerin, Yannick; Padel, Andre (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1970. 15p. (In French). (CONF-701001-9). Dep. CFSTI (U. S. Sales Only).

From 4th International Conference on Plutonium and Other Actinides, Santa Fe, N. Mex.

Young modulus E of mixed uranium plutonium carbides and nitrides was measured as a function of the porosity P(Pu/U + Pu = 0.15 or 0.20) at room temperature: E = 22,5 (1-2, 3P) for carbides (10^{11} dynes/cm^2) E = 28 (1 to 2, 7P) for nitrides. Young modulus of carbonitrides $(U_{0.85}Pu_{0.15})(C_{1-x}N_x)$ is maximum for $x \sim 0.80$. Young modulus of mixed oxides (20°C, P ~ 3.5%) $(U_{0.85}Pu_{0.15})O_{2\pm y}$ is maximum for the stoichiometry y = 0. Young modulus of mixed stoichiometric oxides (20°C, P ~ 3.5%) $(U_{1-x}Pu_x)O_2$ increases with the plutonium concentration. The compressive creep rate ϵ(per hour) of mixed carbonitrides (P ~ 9%) $U_{0.85}Pu_{0.15}C_{0.85}N_{0.35}$, follows the law (between 1150 and 1700°C): $\epsilon \simeq 6.10^{-3}\ \sigma\ 2.3 \pm 0.5 \exp[-(100 \pm 10/RT)]$ (σ stress in kg/cm^2, $80 < \sigma < 660$, R = 1.98 kcal). (auth) (France)

51206 (COO-1441-11) ELECTRICAL CONDUCTIVITY OF SINGLE-CRYSTAL CERIUM DIOXIDE. Brugner, F. S.; Blumenthal, R. N. (Marquette Univ., Milwaukee, Wis. Coll. of Engineering). [1970]. Contract AT(11-1)-1441. 4p. Dep. CFSTI.

The electric conductivity of a CeO_2 single crystal was measured as a function of temperature (1200 to 1500°C) and oxygen pressure (1 to 10^{-13} atm). The data show excellent agreement with normalized conductivity values for 70 and 85% dense sintered specimens; below 1200°C, impurities in the single crystal begin to influence the conductivity. (D.L.C.)

51207 (EUR-4530) URANIUM DISTRIBUTION AND URANIUM DIFFUSION THROUGH THE PYROCARBON COATING IN UO_2 COATED PARTICLES. Busca, G.; Drago, A.; Fenici, P.; Huber, W. (European Atomic Energy Community, Petten (Netherlands). Joint Nuclear Research Center). 15 Apr 1970. 16p. Dep. CFSTI (U. S. Sales Only). EUR FF 4.45.

The uranium diffusion through the pyrocarbon coating of a UO_2 kernel was studied in the temperature range of 1600 to 1900°C. The experimental data fit an equation of the form $D = 4.77 \times 10^4 \exp(-86000/RT)$. The uranium distribution through the coating has been evaluated by means of a micro-grinding technique carried out in the laboratory. A uniform distribution of uranium through the coating except for the buffer layer has been observed. Both experimental results indicate that the uranium diffusion for the range of temperature and type of coated fuel particles considered, is controlled by the kernel composition. (auth)

51208 (LA-4485) METHOD FOR THE NUMERICAL DETERMINATION OF THERMAL CONDUCTIVITY. Buzbee, B. L.; Dorr, F. W. (Los Alamos Scientific Lab., N. Mex.). Jul 1970. Contract W-7405-eng-36. 7p. Dep. NTIS.

A computational procedure is described for determining the thermal conductivity of a material from experimentally determined transient cooling data. (auth)

51209 (SC-T-70-4035) REACTIONS OF CARBON-SATURATED VANADIUM CARBIDE MELT WITH A DISORDERED ARRANGEMENT OF CARBON. Fitzer, E.; Kegel, B. Translated by Marcel I. Weinreich (Sandia Labs., Albuquerque, N. Mex.), from Carbon; 6: 433-46(1968). 33p. Dep. CFSTI.

The reactions of carbon-saturated vanadium carbide melt with carbons of different degrees and types of crystalline order (vitreous, pyrolytic, and natural graphite) were studied in particular regard to the effects of catalytic graphitization. Glasslike carbon was strongly attacked by the vanadium carbide melt and recrystallized into well-ordered graphite. Pyrolytic graphite was also transformed, but much more slowly; whereas natural graphite was devoid of reaction. The driving force was the difference in free enthalpy between (disordered) carbon and (well-ordered) graphite. The precipitation of well-ordered graphite [catalytic graphitization] could also be observed with other carbides and carbon-saturated metallic melts such as: Fe-C, Ni-C, TiC/C, and ZrC/C. (auth)

51210 (UCRL-50901) DYNAMIC YIELD STRENGTHS OF LIGHT ARMOR MATERIALS. Gust, W. H.; Royce, E. B. (California Univ., Livermore. Lawrence Radiation Lab.). 1 Jul 1970. 25p. Dep. CFSTI.

Inclined mirrors and prisms have been used to determine Hugoniot elastic limits (HEL's) for the light ceramics B_4C, BeO, four grades of Al_2O_3, SiC, TiB_2, AlB_{12}, $TiBe_{12}$, Be_2B, and $ZrBe_{12}$; ⟨100⟩, ⟨110⟩, and ⟨111⟩ Si; and a maraging steel, Vascomax 350. Hugoniot parameters to about 1 Mbar were measured for B_4C, BeO, and the four aluminas, and to about 0.5 Mbar for Si. Four-wave shock

structures were observed for ⟨110⟩ and ⟨111⟩ Si. These have been related to the HEL's and to two successive phase transitions. In Vascomax 350, a three-wave structure was seen which appears to be related to the 130-kbar transition in Fe. Three-wave structures were also observed in ⟨100⟩ Si and AlB_{12}. (auth)

51211 SOME DYNAMIC MECHANICAL PROPERTIES OF DISTENDED CARBONS. Lee, L. M.; May, R. P.; Guess, T. R. (Sandia Labs., Albuquerque, N. Mex.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 8: 1421-8(Aug 1970).

An experimental study to define the dynamic response of seven distended carbon materials to shock loading is described and the results are presented. The study included measurement of equation of state parameters to 235 kilobars, unloading behavior, and spallation strengths. In the low-stress (partially compacted) region, the response to shock loading was found to be dependent on the initial structure of the material, i.e., form of carbon and initial density, while in the high-stress region the response was primarily affected by the initial density. The results of the unloading wave experiments, attenuation data, and higher pressure free surface velocity measurements indicated that the unloading behavior of these materials was a function of the applied pressure in the partially compacted region. Accordingly, the Hugoniot data are closely represented by a previously proposed empirical model which describes the response of partially compacted porous materials. The spallation results show differences in the dynamic tensile strengths varying from 0.4 to 1.0 kilobar, depending on the material. (auth)

51212 ENTHALPY OF URANIUM DIOXIDE AND SAPPHIRE TO 1500 K BY DROP CALORIMETRY. Fredrickson, D. R.; Chasanov, M. G. (Argonne National Lab., Ill.). J. Chem. Thermodyn.; 2: 623-9(Sep 1970).

A high-precision drop calorimetric system was used to measure the enthalpy of UO_2 and National Bureau of Standards sapphire in the temperature range 500 to 1500°K, relative to 298.15°K. All temperatures are based on IPTS-48. (auth) (UK)

51213 ENTHALPY OF FORMATION OF PLUTONIUM MONOCARBIDE. Johnson, Gerald K.; van Deventer, Erven H.; Kruger, Owen L.; Hubbard, Ward N. (Argonne National Lab., Ill.). J. Chem. Thermodyn.; 2: 617-22(Sep 1970).

The energy of combustion in oxygen of a specimen of arc-melted plutonium monocarbide ($PuC_{0.978 \pm 0.002}$) was measured in a bomb calorimeter. The standard enthalpy of formation, $\Delta H_f^0(PuC_{0.978 \pm 0.002}, c, 298.15°K)$, was calculated to be $-(11.41 \pm 0.68)$ kcal $mole^{-1}$. (auth) (UK)

51214 TOTAL HEMISPHERICAL EMISSIVITY, SPECTRAL NORMAL EMISSIVITY AT A WAVELENGTH 0.65 μm, AND ELECTRICAL RESISTIVITY OF TANTALUM CARBIDE AT VERY HIGH TEMPERATURES. Petrov, V. A.; Chekhovskoi, V. Ya.; Sheindlin, A.E.; Nikolaeva, V. A. (Inst. of High Temperatures, Moscow). High Temp. - High Pressures; 1: 657-61(1969).

The total hemispherical emissivity, the spectral normal emissivity at a wavelength of 0.65 μm, and the electrical resistivity of tantalum carbide were measured in the temperature range 1200 to 3750°K. The results are compared with those of other authors. (auth) (UK)

51215 THERMODYNAMICS OF THE UO_{2+x} PHASE. I. HEAT CAPACITIES OF $UO_{2.017}$ AND $UO_{2.254}$ FROM 300 TO 1000 K AND ELECTRONIC CONTRIBUTIONS. Groenvold, Fredrik; Kveseth, Nils Joergen; Sveen, Arvid; Tichy, Jiri (Univ. of Oslo). J. Chem. Thermodyn.; 2: 665-79(Sep 1970).

Heat capacities of $UO_{2.017}$ and $UO_{2.254}$ were measured in the range 300 to 1000 K by adiabatic calorimetry. The enthalpy and entropy increments $\{X^0(1000\ K) - X^0(0)\}$ are 66.49 kJ $mole^{-1}$ and 170.2 J K^{-1} $mole^{-1}$ for $UO_{2.017}$, and 72.91 kJ $mole^{-1}$ and 185.7 J K^{-1} $mole^{-1}$ for $UO_{2.254}$. The increments $\{X^0(298\ K) - X^0(0)\}$ are based upon literature data. In $UO_{2.017}$ the presence of the U_4O_9 phase causes slightly variable heat capacities in the range 300 to 360 K due to a partial suppression of the transition in U_4O_9 in the supersaturated solid solution of U_4O_9 in UO_2. Augmented heat capacity values are observed in the range 500 to 800 K due to the solution of U_4O_9 in UO_2. In $UO_{2.254}$ a λ-type transition is present with maximum at 348 K and an entropy increment of 2.18 J K^{-1} $mole^{-1}$, presumably connected with interchange of interstitial and displaced oxygen atoms. A small irregularity in the heat capacity is observed in the region 900 to 950 K with an entropy increment of 0.15 J K^{-1} $mole^{-1}$. It is superimposed on a general increase in the heat capacity, presumably due to the onset of a transition. Attempts to resolve the various contributions to the heat capacity of UO_2 show that the electronic contribution is large. The results for $UO_{2.254}$ also indicate a large electronic contribution. (auth) (UK)

51216 MODERN ASPECTS OF GRAPHITE TECHNOLOGY. Blackman, L. C. F. (ed.). London; Academic Press (1970). 330p. 100s.

The subject is treated under the following headings: polycrystalline carbon and graphite; manufacturing technology of baked and graphitized carbon bodies; electron transport in graphites and carbons; thermal gas reactions of graphite; mechanical properties; friction and wear; and industrial applications of carbon and graphite. (UK)

51217 DIFFUSION OF ACTINIDES IN PYROCARBONS: THIN-LAYER EXPERIMENTS. Evans III, R. B.; Stiegler, J. O.; Watson, G. M. (Oak Ridge National Lab., Tenn.). J. Appl. Phys.; 41: 4808-19(Nov 1970).

The diffusion of uranium and thorium in columnar pyrocarbons between temperatures of 1450° and 2065°C has been studied using the usual thin-layer depletion technique. Constant coefficients are obtained that are in good agreement with results reported elsewhere for uranium diffusion in the ⟨α⟩ direction at actinide concentrations less than about 0.15-mg actinide/cm^3. Diffusion coefficients increase at higher actinide concentration. The anisotropic pyrocarbons are well oriented with the basal planes aligned parallel to the deposition surface. Diffusion coefficients parallel to the deposition surfaces are about three orders-of-magnitude greater than those in the perpendicular direction. The difference is due primarily to the pre-exponential term in the usual Arrhenius equation. Autoradiographic studies of specimens in which diffusion occurred perpendicular to the deposition surface show segregation of actinides to growth cone centers or boundaries depending on whether diffusion occurs along or opposite the direction of growth of the pyrocarbon. The segregation is attributed to rapid diffusion parallel to the deposition surface coupled with the roughened nature of the surface. The results are discussed in terms of previously proposed models for actinide diffusion in columnar pyrocarbons. (auth)

Structure and Phase Studies

51218 (CEA-CONF-1589) STUDY OF CARBIDE-TYPE COMPOUNDS: PHASE DIAGRAMS AND PROPERTIES. Lorenzelli, Robert; Delaroche, Pierre; Housseau, Maurice; Petit, Pierre (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1970. 18p. (In French). (CONF-701001-6). Dep. CFSTI (U. S. Sales Only).

From 4th International Conference on Plutonium and Other Actinides, Santa Fe, N. Mex.

In order to improve the properties of the carbides (U,Pu)C, a study of the carbide-type compounds (carbides, nitrides, carbonitrides and oxicarbides) was made. These compounds were obtained by natural sintering in vacuum at temperatures from 1400 to 1750°C. The following phase diagrams: (U,Pu)C; (U,Pu)N; (U,Pu)C,N; (U,Pu)C_2O; (U,Pu)N_2O, were investigated for a Pu/(U + Pu) ratio between 15 and 25 at %. The phase limits in the mixed (U,Pu) systems are very close to those of the equivalent uranium systems. The pseudo ternary phase diagram MC–MN–MO was studied. Properties, such as compatibility with cladding materials, thermal conductivity, and elastic constants were investigated. With a sodium band, it was shown that carburizing of a stainless steel (316 L) cladding remains low in all cases after a 4000 hour annealing at 700°C. In the case of carbonitrides, anomalies in thermal conductibility and Young's modulus are due to the non ideality of the solid solution (U,Pu)C,N on its nitrogen rich side. (auth) (France)

51219 (COO-1109-52) SOLID STATE CHEMISTRY OF RARE EARTH OXIDES. Technical Progress Report, 1969–1970. Eyring, LeRoy; Felmlee, Theron L.; Fox, Donald L.; Haschke, John M.; Lowe, Arthur T. (Arizona State Univ., Tempe). 1 Jul 1970. Contract AT(11-1)-1109. 96p. Dep. CFSTI.

Progress is reported on the solid state chemistry of rare earth oxides in the areas of hydrothermal crystal growth, phase relationships in the rare earth oxides, heterogeneous isotope exchange studies, the ternary $U_xPr_yO_z$ system, and the rare earth formates. (D.H.M.)

51220 CALCULATION OF THE Ga–In–P TERNARY PHASE DIAGRAM USING THE QUASI-CHEMICAL EQUILIBRIUM MODEL. Stringfellow, G. B. (Hewlett-Packard Co., Palo Alto, Calif.). J. Electrochem. Soc.; 117: 1301-5(Oct 1970).

The Ga–In–P solid–liquid–vapor equilibrium phase diagram has been calculated based on the quasi-chemical equilibrium solution model. The calculated phase diagram, both isothermal liquidus and iso-(solid concentration) lines, and P_2 and P_4 vapor pressure curves, is found to be in agreement with recently published experimental data. (auth)

51221 PHASE DIAGRAM OF THE Zn–Cd–Te TERNARY SYSTEM. Steininger, Jacques; Strauss, Alan J.; Brebrick, Robert F. (Massachusetts Inst. of Tech., Lexington). J. Electrochem. Soc.; 117: 1305-9(Oct 1970).

The ternary Zn–Cd–Te liquidus surface and the pseudobinary CdTe–ZnTe solidus curve have been determined by thermal analysis of cooling and heating curves, respectively, of homogenized liquid and solid alloy samples. The binary Cd–Te and Zn–Te liquidus arrest temperatures are in good agreement with most of the previously published data and confirm the presence of well-defined inflections on the metal-rich and Te-rich sides of both liquidus curves. The binary interchange energy parameters calculated along each liquidus curve for the regular and quasi-chemical approximation solution models give essentially similar values for dilute solutions. Near equiatomic composition however, they show values respectively in excess of 200 kcal/mole and less than 40 kcal/mole. The pseudobinary CdTe–ZnTe liquidus and solidus curves exhibit monotonic and sublinear increases in temperature with increasing ZnTe content. The gap between the two curves remains less than 0.16 mole fraction and shows excellent agreement with the values calculated from the ideal liquidus-solidus thermodynamic relationship. The ternary liquidus temperatures form a smooth surface with a narrow ridge near the pseudobinary CdTe–ZnTe composition line and practically degenerate ternary eutectic and boundary lines. (auth)

51222 HIGH-TEMPERATURE RADIOGRAPHY OF OXIDE MATERIALS. 1. THE INVESTIGATION OF THE MONOCLINIC–TETRAGONAL TRANSFORMATION OF ZrO_2. Strekalovskii, V. N.; Zubankov, V. N.; Pal'guev, S. F. Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural. Filial; No. 12, 120-9(1969). (In Russian).

The modificational transition of ZrO_2 specimens from various starting materials was studied by high temperature radiography. The formation of the tetragonal structure is initiated at 1100°C and is completed at 1250 to 1270°C. The monoclinic structure does not redevelop. High temperature tetragonal ZrO_2 has the primitive cell form. (J.R.D.)

51223 CONDUCTIVITY IN MIXED PHASES OF THE SYSTEM ZrO_2–La_2O_3. Volchenkova, Z. S. Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural. Filial; No. 12, 114-19(1969). (In Russian).

The electric conductivity was studied in La_2O_3–ZrO_2 specimens sintered at 1550°C using emf measurements. The fractional oxygen ion conductivities were determined and established by the RHo-type electron component. The investigations were conducted at 550 to 1000°C. A temperature curve relating ionic and electronic conductivities was plotted and the ionic activation energy was calculated together with the electron conductivity. (J.R.D.)

51224 STRUCTURE AND ELECTRIC CONDUCTIVITY OF THE SYSTEM ZrO_2–Y_2O_3 CONTAINING ADDITIONS OF OXIDES OF Fe, Mn, Co, AND Ni. Neuimin, A. D.; Kotlyar, A. G.; Pal'guev, S. F.; Strekalovskii, V. N.; Batrakov, N. A. Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural. Filial; No. 12, 92-113(1969). (In Russian).

Petrographic and x-ray investigations were made of the system ZrO_2–Fe_2O_3 and of the systems ZrO_2–Y_2O_3–Fe_2O_3, ZrO_2–Y_2O_3–Mn_2O_4, Y_2O_3–ZrO_2–CoO, and ZrO_2–Y_2O_3–NiO, in which the ratio of ZrO_2 to Y_2O_3 was 90 to 10 in each system. It was found that in the 9-to-1 ZrO_2–Y_2O_3 mixture, additions of Fe_2O_3, Mn_3O_4, CoO, or NiO followed by calcination at less than 1550°C, promote stabilization of ZrO_2 in cubic form. (J.R.D.)

51225 X-RAY DIFFRACTION ANALYSES OF ZIRCONIA FILMS ON ZIRCONIUM AND ZIRCALOY-2. Roy, C.; David, G. (Univ. of Western Ontario, London). J. Nucl. Mater.; 37: 71-81(Oct 1970).

X-ray diffraction studies by both the reflection and transmission techniques were made on oxide films formed on crystal-bar zirconium and Zircaloy-2 in oxygen at 500°C. The variations in the structural characteristics of the oxide with film thickness gave rise to a double-layered scale, i.e., an initially formed layer consisting of ZrO_2 crystallites with some degree of orientation in an amorphous matrix over a recrystallized, textured oxide. The onset of a second mode of film growth is a consequence of the formation of tetragonal zirconia at the metal-oxide interface due to high local stresses. The existence of a stress gradient in the oxide film enables the tetragonal/monoclinic transformation of the crystallites to occur at some distance from the interface; this appears to be an intermediate step in the development of a columnar morphology. (auth)

51226 EFFECT OF OXIDE ADDITIONS ON THE POLYMORPHISM OF TANTALUM PENTOXIDE. II. "STABILIZATION" OF THE HIGH TEMPERATURE STRUCTURE TYPE. Roth, R. S.; Waring, J. L.; Brower, W. S. (National Bureau of Standards, Washington, D. C.). J. Res. Nat. Bur. Stand.; 74A: 477-84(Jul–Aug 1970).

The high temperature, apparently tetragonal, polymorph of tantalum pentoxide can be obtained at room temperature by quenching a specimen containing 2 to 5 mole percent of the following oxides: SnO_2, Ga_2O_3, Cr_2O_3, Fe_2O_3, Sc_2O_3, or MgO. All the x-ray patterns can be indexed on a body centered tetragonal cell with $a \approx 3.830$ Å, $c \approx 35.68$ Å. However, P_2O_5, V_2O_5, Nb_2O_5, ZrO_2, Lu_2O_3, NiO, or ZnO do not stabilize the tetragonal form at room temperature. Single crystals of scandium stabilized Ta_2O_5 have been grown by the Czochralski technique. (auth)

51227 EFFECT OF OXIDE ADDITIONS ON THE POLYMORPHISM OF TANTALUM PENTOXIDE. III. "STABILIZATION" OF THE LOW TEMPERATURE STRUCTURE TYPE. Roth, R. S.; Waring, J. L. (National Bureau of Standards, Washington, D. C.). J. Res. Nat. Bur. Stand.; 74A: 485-93(Jul–Aug 1970).

The "low temperature structure type" of Ta_2O_5 has been found to occur in two distinct forms with the lowest temperature form having a unit cell 14 times the subcell and an intermediate temperature form with a unit cell 11 times the subcell. The two types form intermediate partially ordered mixtures which are apparently in thermal equilibrium at various temperatures between ~1000 and 1350°C. The addition of MoO_3, WO_3, SiO_2, GeO_2, ZrO_2, TiO_2, B_2O_3 and Al_2O_3 each affect the multiplicity of the true unit cell in different ways. WO_3, SiO_2, GeO_2, B_2O_3, and Al_2O_3 form phases structurally similar to "low-Ta_2O_5" which are stable up to the solidus temperatures of the corresponding systems. (auth)

51228 ELECTRON-DIFFRACTION STUDY OF STRUCTURE OF TANTALUM CARBIDES. Terao, Nobuzo (Union Carbide European Research Associates, Brussels). Jap. J. Appl. Phys.; 9: 1263-7(Oct 1970). (In French).

Thin films of tantalum carbides were prepared by heating the doubly evaporated film of tantalum–carbon in vacuum at high temperature and the existence of two phases was identified by electron-diffraction analysis: TaC and Ta_2C. The TaC phase has the NaCl cubic structure and its lattice parameter varies largely according to the composition. In the most carbon-deficient crystal, the lattice parameter is a = 4.42 Å and it increases to a = 4.458 Å corresponding to the stoichiometric TaC. The Ta_2C phase has the C6 structure ($P\bar{3}m$ 1-D^3_{3d}), similar to the CdI_2 antitype structure. The lattice parameters are a = 3.104 Å and c = 4.938 Å (c/a = 1.591). (auth)

Radiation Effects

Refer also to abstracts 51793 and 52916.

51229 (BNWL-tr-55) STRUCTURAL CHANGES IN BRIEFLY TREATED URANIUM DIOXIDE WITH AND WITHOUT NEUTRON IRRADIATION AS AN AID IN DETERMINING TEMPERATURE DISTRIBUTION IN FUEL ELEMENTS FOR NUCLEAR REACTORS. Hoechel, J.; Saur, G.; Borchers, H. Translated from J. Nucl. Mater.; 33: 225-41(1969). 28p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 24: 4819.

51230 (DP-Report-385) INTERPRETATION OF DRAGON DATA. Project DRAGON. Ashworth, F. P. O. (Atomic Energy Establishment, Winfrith (England)). Nov 1965. 48p. Dep. CFSTI (U. S. Sales Only).

The information on the Dragon Reactor Experiment is examined and a system of analysis for fuel evaluation is proposed. This is based on the objectives of an experiment and the measurements made during the fuel characterization, irradiation, and examination stages. The proposed organization of the data takes into account the strictly limited number of samples which can be examined, the comparison of results with previous work and the dependence of their value on the speed with which they can be applied. (auth)

51231 (DP-Report-387) FUEL IRRADIATION EXPERIMENTS IN THE R2 REACTOR AT STUDSVIK, SWEDEN. Project DRAGON. Blomquist, R. (Aktiebolaget Atomenergi, Studsvik (Sweden)); Hammar, L.; Lindgren, S.; (and others). Nov 1965. 201p. Dep. CFSTI (U. S. Sales Only).

For Atomic Energy Establishment, Winfrith, Eng.

The effects of in-pile irradiation on fuel particles were investigated. Carbon coated thorium carbide–uranium carbide particles and similar SiC–C coated particles were irradiated along with carbon coated uranium carbide–zirconium carbide particles coated with carbon. It was found that the coatings retained fission products well in most cases; Sr was found to diffuse faster than other induced radioisotopes. The smallest release occurred in SiC-coated particles. (J.R.D.)

51232 (DP-Report-412) STRUCTURAL CHANGES IN COATED PARTICLES IRRADIATED OVER A WIDE RANGE OF BURN-UP AND TEMPERATURE. Project DRAGON. Rose, K. S. B.; Symes, B. J.; Sayers, J. B. (Atomic Energy Research Establishment, Harwell (England)). Mar 1966. 33p. (AERE-R-5159). Dep. CFSTI (U. S. Sales Only).

Results from irradiating a variety of experimental HTR fuels (with N values of 3 and 5) to 8 to 12% fima burn-up, when compared with previous irradiations of the same fuel to 2 to 4% fima, show that once initial structural changes have occurred in the kernel and coating, usually at less than 2% fima, neither the nature nor the extent of the changes alters at burn-ups up to 10% fima. The only exception was a melted $(Th,U)C_2$ fuel which split its pyrocarbon coating; the fracture stresses probably being created by kernel swelling. An initially sintered UC_2 fuel coated with pyrocarbon, however, remained intact after 47% fima in spite of considerable swelling of the fuel kernel. Irradiation at <300°C appears no more damaging than that at 1000°C and above. Qualitatively the same mechanisms appear to be operating, therefore kernel sintering and pyrocarbon dimensional changes are produced by fission rather than thermal energy. The burn-up dependence of irradiation changes in pyrocarbon coated UC_2 fuel has been studied in detail at an irradiation temperature of 600°C. Irradiation induced sintering begins after a burn-up of 0.2% fima and is nearly complete at 2% fima. Spearhead attack in low density, isotropic pyrocarbon was not apparent after a dose of 2×10^{16} fission fragments cm^{-2} but was fully developed after 2×10^{17} fission fragments cm^{-2}. (auth)

51233 (EURAEC-2143) THERMAL BEHAVIOR OF PLUTONIUM AND URANIUM OXIDE CERAMIC FUELS UNDER HIGH SPECIFIC RATING IRRADIATION. CONFIRMATORY EXPERIMENTS. PART II. ZIRCALOY CLADDING. Special Report No. 15, Part Final. Lhost, A.; van Outryve d'Ydewalle, B. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium). Societe Belge pour l'Industrie Nucleaire, Brussels). Dec 1969. Contract 001-64-1-TRUB. 47p. (BN-6912-1). Dep. CFSTI.

Work performed under United States-Euratom Joint Research and Development Program.

The effects of irradiation in the Belgian BR-2 reactor on Zircaloy-clad vibrated plutonium fuels were studied. Plutonium recycling possibilities in BWR types are discussed. According to post-irradiation data currently available, power generated in the rods was around 800 W/cm; however, metallographic interpretations led to the belief that the power was more than 900 W/cm. These values will be compared with those drawn from irradiations in hand at the end of 1969. (auth)

51234 PRECIPITATION INDUCED BY NEUTRON IRRADIATION OF Fe-C ALLOYS. Damask, A. C. (Queens Coll., Flushing. Brookhaven National Lab., Upton, N. Y.); Chow, J. G. Y.; Kelsch, J. J.; Wagenblast, H. Phil. Mag.; 22: 549-62(Sep 1970).

Electron micrographs were taken of some Fe-C alloys following neutron irradiation and an anneal designed to intensify the precipitates. Counts were made and averaged for 75, 100 and 150 ppm (wt.) carbon concentrations for radiation doses at 30°C for times ranging from 5 min to 68 hours. After irradiations of 2 to 7 hours the number of precipitate particles is roughly comparable to the number of primary knock-ons, and therefore the spike which results from the knock-on is believed to be a site for heterogeneous nucleation. After short-time irradiation it was found that an unexpectedly large number of precipitates are formed, the maximum occurring after about 30 min irradiation and having a concentration of about 50 times the number of knock-ons. These precipitates are stable with respect to temperature up to 100°C but they do not appear following irradiation at -78°C. Computer calculations of a simplified reaction of iron interstitials with single, di- and tricarbons indicate that the iron interstitial bound to two carbon atoms is the basic nucleus for the short-time precipitates. (auth) (UK)

51235 SIMULATION OF FISSION DAMAGE IN U_3Si. Walker, D. G. (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Nucl. Mater.; 37: 48-58(Oct 1970).

The feasibility of simulating fission damage in U_3Si by means of ion bombardment is examined theoretically and experimentally. For ambient temperature irradiations, the changes in x-ray diffraction patterns produced by neutron irradiation can be reproduced by bombardment with 2 MeV argon. The values of ion fluence and fission density to give the same degree of damage are in the ratio 1:1000 which is in good agreement with the calculated ratio assuming that the damage is proportional to the amount of energy deposited in atomic collisions. Radiation swelling in the bombarded layer was measured by interferometry and was found to agree with values obtained from neutron irradiated material. Microhardness measurements suggest that although U_3Si is hardened by irradiation, U_3Si_2 undergoes irradiation softening. (auth)

Plastics and Other Materials

Refer also to abstracts 51409 and 51807.

51236 (AD-708024) NEUTRON ACTIVATION OF PORTLAND CEMENTS. Penaranda, F. E. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Feb 1968. 32p. (AFRRI-TN-68-2). NTIS.

A study was made of the neutron activation properties of Portland cements according to their manganese and sodium contents (as the chief activating constituents of cements in the time frame of interest). The purpose was to select a low activating cement to be used in the construction of an exposure room capable of housing a high intensity 14-MeV neutron source. Relatively low activating limestone was chosen for the fine and coarse aggregates of the concrete. Five hundred samples of cement were analyzed employing thermal neutron activation analysis techniques, and the results are presented in several tables showing the geographical origin of the samples, mill and type, plus sample distribution as a function of sodium and manganese concentration. (auth) (USGRDR)

51237 (CEA-CONF-1584) EFFECTS OF NEUTRON RADIATIONS ON SPECIAL CONCRETES AND THEIR COMPONENTS. Elleuch, M. F.; Dubois, F.; Rappeneau, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1970. 37p. (In French). (CONF-701007-1). Dep. CFSTI (U. S. Sales Only).

From Meeting on Concretes Used in Nuclear Reactors, Berlin, Germany.

A brief description of the irradiation devices and measurement methods is given, followed by a discussion of the results obtained with heat insulating concretes based on serpentine granulates bound with an aluminous cement, irradiated at temperatures of about 250°C with flux densities up to 10^{20} n/cm^2 (energy > 1 MeV). Appreciable changes in mechanical properties and dimensions were observed: decrease of the bending tensile strength and compressive breaking strength; swelling of the material to 700μ/m. In order to determine the part played by each component in the changes observed with this type of concrete, serpentine test pieces and pure aluminous cement paste were irradiated under the same conditions. The interpretation of the results obtained demonstrated the dominant role played by the granulates in determining the properties of neutron irradiated concrete. (auth) (France)

51238 (DUN-SA-141) DEVELOPMENT OF A LONG-LIVED, HIGH-EXPANSION FOAM FOR ENTRAPPING AIR-BEARING NOBLE GAS. Mecca, J. E. (Douglas United Nuclear, Inc., Richland, Wash.); Ludwick, J. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug 1970. Contract AT(45-D-1857). 35p. (CONF-700816-3). Dep. CFSTI.

From 11th AEC Air Cleaning Conference, Richland, Wash.

Development of a high expansion foam (300 to 1 expansion ratio) with the ability to withstand time (120 days or more) without the loss of internal structural integrity is described. The technique of blowing the foam with a flooded impingement plate, thus requiring no nozzles or devices prone to plugging, has proven to be quite reliable and successful. A description of facilities and instrumentation, as well as presentation of data from tests performed on a small bench top facility used to evaluate about 250 foam candidates, is presented. The large facility used to successfully encapsulate quantities of 5,000 cubic feet of air-bearing, tagged noble gas at various ppM per cubic foot of air, is also described. The foam development work and techniques employed appear useful for controlling industrial gaseous emissions, dust suppression, gas scrubbing of reactor containment vessels, and possibly in agriculture as an insulator for the prevention of frost damage. (auth)

51239 (N-70-25471) RADIATION EFFECTS IN SILICON SOLAR CELLS. Quarterly Report. Passenheim, B. C.; Berger, R. A.; Colwell, J. F.; Leadon, R. E.; Naber, J. A. (Gulf General Atomic, Inc., San Diego, Calif.). 10 Apr 1970. Contracts NAS7-100; JPL-952387. 18p. (NASA-CR-109618; GA-10061). NTIS.

The effects of lithium on the production and annealing of damage in silicon are considered. This work was performed on lithium-diffused bulk silicon using measurements such as minority-carrier lifetime, electron-spin resonance (ESR), electrical conductivity, and infrared absorption. The temperature range from 77.5 to 400°K was investigated. The effects of 30-MeV electrons and fission neutrons were studied. (auth) (STAR)

51240 (RHEL/R-200) POST IRRADIATION MECHANICAL PROPERTIES OF EPOXY RESIN/GLASS COMPOSITES. Evans, D.; Morgan, J. T.; Sheldon, R.; Stapleton, G. B. (Rutherford High Energy Lab., Chilton (England)). Jun 1970. 19p. Dep. CFSTI (U. S. Sales Only). UK 3s. 6d.

Fourteen epoxy resin systems were examined. The data indicated that a significant advantage can be gained in the radiation stability of epoxy composites by the use of tri- or tetra-functional glycidylamines, which can withstand doses of 10^{10}R without change in physical properties. These resins, in combination with liquid

methyl "nadic" anhydride, have a low viscosity and a long room temperature "pot life" and are therefore useful impregnating materials in magnet coil fabrication. (UK)

51241 EFFECT OF HIGH TEMPERATURE ON THE THERMAL CONDUCTIVITY OF CONCRETE. Volkov, G. A.; Dubrovskii, V. B.; Pospelov, V. P., Sb. Tr., Mosk. Inzh.-Stroitel. Inst.; 56: 11-18(1968). (In Russian).

Data are presented on thermal conductivities of heat-resistant concretes in the temperature range of 100 to 1100°C. All concretes from one institute except those with a magnesite filler showed a linear increase in thermal conductivity with increasing temperature as follows with the thermal conductivity being given in kcal/m · hr · °C, 1.14 at 100°C to 1.28 at 300°C for ordinary concrete; 1.14 at 100°C to 1.4 at 900°C for a chromite concrete; 1.04 at 100°C to 1.39 at 900°C for a basalt, diabase or andesite concrete; 0.64 at 100°C to 1.10 for a burnt clay concrete; 5.10 at 100°C to 3.10 kcal/m · hr · °C at 900°C for a magnesite concrete. The thermal conductivities of these concretes are determined mainly by the filling material. With other types of concretes the thermal conductivity depends also on the type of binding agent with sodium silicate giving a somewhat higher thermal conductivity than portland cement does, as illustrated by the following thermal conductivities: 1.00 at 200°C and 0.68 at 600°C for a chromite concrete with portland cement, and 1.10 at 200°C and 0.70 kcal/m · hr · °C for a chromite concrete with sodium silicate as the binding agent. The thermal conductivity of a concrete is decreased somewhat by continued exposure at elevated temperature. The distribution of temperatures in chromite concrete shielding is presented with the change in thermal conductivity with temperature being taken into account. (TTT)

51242 STATIC COMPUTATION OF TEMPERATURE STRESSES IN REINFORCED CONCRETE SHIELDING CONSTRUCTION. Pergamenshchik, B. K.; Khol'tsov, A. V.; Shershnev, S. T. Sb. Tr., Mosk. Inzh.-Stroitel. Inst.; 56: 23-4(1968). (In Russian).

Higher temperature drops of 200 to 300°C in reinforced concrete can be allowed with the formation of cracks 0.1 to 0.3 mm wide. As a rule, crack propagation does not go beyond 10 to 20% of the shield thickness. Classic elasticity theory can be applied at temperature drops of 20 to 30°C. The temperature limits can be extended to 150 to 200°C, if the possibility of crack formation is allowed. If the linear expansion coefficient and modulus of elasticity of the concrete are allowed to vary with temperature, it is possible to calculate the temperature stresses and amount of reinforcing steel as a function of the temperature drop. Thus it is found that for a cylinder with an internal radius of 3 m and an external radius of 4 m, the maximum compressive tension in the concrete is 35 kg/cm² at a temperature drop of 60°C and steel reinforcement of 52 kg/m³, 65 kg/cm² at a temperature drop of 100°C and steel reinforcement of 83 kg/m³, 124 kg/cm² at a temperature drop of 150°C and steel reinforcement of 166 kg/m³, and 210 kg/cm² at a temperature drop of 200°C and steel reinforcement of >320 kg/m³. Stresses for higher temperature drops are calculated but the underlying assumptions become less reliable. It is shown that significant temperature drops are not a bar to the use of concrete as shielding from radiation. The amount of steel reinforcement, the size of the cracks, the deformation and stresses are such that ordinary concrete can be used at temperatures up to 200 to 300°C. (TTT)

51243 PRESTRESSED CONCRETE PRESSURE VESSEL FOR NUCLEAR POWER PLANTS. Disapia, R. (Comitato Nazionale per l'Energia Nucleare, Bologna); Giovagnoli, M. Calore; 41: 207-25(1970). (In Italian).

Prestressed concrete pressure vessels are widely employed in the most up-to-date nuclear technology, especially for high power reactors, either for the easy solution to many difficult technical problems due to the large size of modern nuclear power stations or for conceptual design simplicity and high operational degree of reliability and safety. After a short description of several kinds of such vessels, the design criteria and test standards, which are in use in different countries such as the United Kingdom and France, are reported and discussed. Moreover several characteristics of existing prestressed concrete pressure vessels are tabulated. Physical and mechanical pressure vessel concrete characteristics are studied in detail. (INIS)

PHYSICS (GENERAL)

Astrophysics and Cosmology

Refer also to abstract 52477.

Stars

51244 (AD-708452) MODEL ATMOSPHERES FOR DEGENERATE STARS. Final Report. Kumar, Shiv S. (Virginia Univ., Charlottesville). 1970. Contract N00014-69-A-0060-0001. 5p. NTIS.

A general program for the computation of model atmospheres for degenerate stars was written in Algol for the B5500 computer at the University of Virginia. The program has been used to study the atmospheric structure of (λ) 4670 stars and DG stars. New model atmospheres were obtained for these stars and the comparison of these models with the observed data (spectra, colors, etc.) is in progress. (USGRDR)

51245 (N-70-27019) X RADIATION IN BINARY STARS. Schocken, Klaus (National Aeronautics and Space Administration, Huntsville, Ala. George C. Marshall Space Flight Center). 13 Mar 1970. 17p. (NASA-TM-X-53998). NTIS.

The properties of close binary stars and old novae as they are known are summarized. A binary system originates with or results from the splitting of a single star into two components caused by rotational instability during the contraction of the star. The assumption is made that, to become a nova, it is a necessary condition for the star to be a member of a close binary system consisting of a blue and a red star, with a stream of gas flowing from the red to the blue star and forming a shell around the blue star to generate the observed bright emission lines that indicate that this gaseous shell moves with the blue star. Assuming that the explosive process has taken place in the nova, a shock wave will penetrate the surface, forming an expanded atmosphere in a time that is too short for appreciable loss of radiation. When an electric field exists in a plasma with a density such that the electrons whose velocity surpasses a certain critical value will gain more energy from the field than they lose by collisions, runaway electrons will be generated. The hypothesis is made that runaway electrons are the source of deceleration x radiation in the atmosphere of a nova. (auth) (STAR)

51246 (N-70-27347) GENERATION OF X RAYS IN PLANETARY NEBULAE. Schocken, Klaus (National Aeronautics and Space Administration, Huntsville, Ala. George C. Marshall Space Flight Center). 12 Feb 1970. 19p. (NASA-TM-X-53996). NTIS.

Planetary nebulae emit continuous radiation that originates by free-free transitions involving kinetic energy losses of free electrons in the electrostatic fields of ions. These free-free emissions are responsible for the radiation observed in the radio-frequency spectra. They also contribute in the visible and infrared regions. Therefore, if x rays are generated by planetary nebulae, it can be assumed that they will also be produced by free-free transitions. However, free-free radiation will be measured along with free-bound radiation. A formula is given for the intensity of the combined continuum for an ionized gas with a Maxwellian distribution of the electron velocities. (auth) (STAR)

51247 (N-70-29796) CALCULATIONS OF ASTROPHYSICAL PARTITION FUNCTIONS. Hagyard, M. J. (National Aeronautics and Space Administration, Huntsville, Ala. George C. Marshall Space Flight Center). 16 Feb 1970. 22p. (NASA-TM-X-53984). NTIS.

A method for the calculation of the internal energy partition function of an atom or ion immersed in a plasma is presented. Sample calculations are made at various temperatures and electron pressures, and the numerical results are compared with those of other authors. The importance of the contributions of higher parent terms is clearly demonstrated. (auth) (STAR)

51248 ABUNDANCES AND STELLAR ROTATION. Tuominen, Ilkka V.; Vilhu, Osmi (Univ. of Helsinki). Astrophys. Lett.; 6: 143-5(Sep 1970).

Results are presented concerning the effect of uniform rotation on equivalent widths of spectral lines in the pole-on case. Among the strong lines studied (Mg II 4481, Si II 4128, Ca II 3933, and O I 8446) the effect is significant only for the line Ca II 3933. For unsaturated weak lines the effect is considerable, and most significant for the Eu II and Sr II type lines. In addition, the rotation causes high Fe I/Fe II ratios. The results differ qualitatively and quantitatively from those of Collins (1968), obviously because of an error in the latter's calculations. (auth)

51249 CONDUCTIVITY IN NEUTRON STAR CRUSTS. Canuto, V.; Solinger, A. B. (Goddard Space Flight Center, New York). Astrophys. Lett.; 6: 141-2(Sep 1970).

The conductivity in the crust of neutron stars was calculated by two different methods. The results were compared and found to be in good agreement in the range of applicability. Thus the simple formula $\sigma = \text{const} \times T_8^{-1}\rho_6^{\frac{1}{2}}\,\text{sec}^{-1}$ describes the electrical conductivity under conditions appropriate to the outer kilometer or so of the star ($T_8 = 10^{-8}T$, $\rho_6 = 10^{-6}\rho/\mu e$). (auth)

51250 MASS LOSS, ROTATION, AND THE LOCATION OF RED SUPERGIANTS IN THE H-R DIAGRAM. Stothers, Richard; Chin, Chao-wen (Goddard Inst. for Space Studies, New York). Astrophys. Lett.; 6: 135-9(Sep 1970).

Mass loss and rotational mixing are shown on theoretical and observational grounds to be inadequate mechanisms to account for the relative paucity of red supergiants of high mass. The only known mechanism which may be responsible remains neutrino emission. (auth)

51251 CHEMICAL COMPOSITION OF THE BINARY SYSTEM α CEN. Powell, A. L. T.; French, V. A. (Royal Greenwich Observatory, Herstmonceux, Eng.). Astrophys. Lett.; 6: 131-3 (Sep 1970).

The position of α Cen A and α Cen B in the two-color diagram is discussed in relation to their chemical composition. Both stars have a composition similar to that of the Sun, but α Cen B has been found to have an ultraviolet deficiency relative to the Hyades. A similar anomaly in the case of δ Pav has been previously explained by the existence of a large microturbulent velocity. However, results of a differential curve-of-growth analysis show α Cen B to have a microturbulent velocity slightly less than that of the Sun. (auth)

51252 PHOTOMETRY OF THE PECULIAR EMISSION OBJECT HBV 475. Kohoutek, L.; Bossen, H. (Hamburger Sternwarte, Hamburg). Astrophys. Lett.; 6: 157-60(Sep 1970).

The light curve in B magnitudes of the emission object HBV 475 has been obtained. In the period 1905-1939 no large variations around the mean value of 15.5 mag were observed with the sole exception that, in September 1934, B = 16.6 mag. The secular increase in brightness began after 1940 and a sudden light change must have occurred during the years 1962-1967. Short-period variations are probably present. The mean V magnitude and colors from photoelectric observations in September 1969 were V = 12.02, B-V = +0.37, U-B = -0.93. (auth)

51253 OBSERVABLE CONSEQUENCES OF ACCRETION BY DEFUNCT PULSARS. Ostriker, Jeremiah P. (California Inst. of Tech., Pasadena); Rees, Martin J.; Silk, Joseph. Astrophys. Lett.; 6: 179-84(Sep 1970).

If the magnetic field of old pulsars is small, then the defunct pulsars, or neutron stars, should accrete interstellar matter. Since each gram of accreted matter falls into a very deep potential well, and there are expected to be a very large number of accretors, the total energy liberated by this process may be nontrivial. The total luminosity due to accretion onto dead pulsars is estimated and the spectrum of the emitted radiation is discussed. A galactic plane enhancement at soft x-ray energies, $\lesssim$0.25 keV, is predicted. The closest neutron star may be detectable as a discrete source. (auth)

51254 OBSERVATIONS OF NGC 7027 AT 5 GHz. Wynn-Williams, C. G. (Mullard Radio Astronomy Observatory, Cambridge, Eng.). Astrophys. Lett.; 6: 189-92(Sep 1970).

The planetary nebula NGC 7027 was mapped at 5 GHz with 6.5 arc sec resolution. The thermal nature of the continuum was confirmed and an electron temperature of 12,000 K $\pm$ 3000 K derived. It is shown that the absence of the H 109α line reported by Terzian and Balick (1969) could be due to Stark broadening, which would imply electron densities $\geq 2.7 \times 10^5$ cm^{-3}. From the shape of the radio spectrum it was deduced that the scale of the density fluctuations must be much smaller than the size of the nebula. (auth)

51255 MAGNETIC FIELDS OF EXPLODING STARS. Mustel, E. R. (Astronomical Council, Moscow). Astrophys. Lett.; 6: 207-10(Oct 1970).

Some basic properties of the envelopes around novae and supernovae are compared. It is concluded that the supernovae have very strong magnetic fields. A model for the supernova explosions is suggested. (auth)

51256 SEARCH FOR METAL-DEFICIENT STARS. Bond, Howard E. (Univ. of Michigan, Ann Arbor. Kitt Peak National Observatory, Tucson, Ariz.). Astrophys. J., Suppl. Ser.; 22: No. 184, 117-55(Sep 1970).

Objective-prism plates taken with the Curtis Schmidt telescope were searched for previously unknown metal-deficient stars, with the purposes of increasing the number of such objects known and of investigating the extent to which the properties of the previously known sample were due to proper-motion selection effects. Four-color Strömgren photometry was obtained for over 250 seventh- to ninth-magnitude suspected weak-lined stars found on the objective-prism plates. This photometric system separates the effects of differing stellar metal contents, temperatures, and luminosities with an accuracy somewhat higher than that attained by visual classification of low-dispersion slit spectrograms, especially for stars with very weak metallic lines. (W.D.M)

51257 TIME-CONSTANT LOCI AND THEORETICAL LUMINOSITY FUNCTIONS FOR METAL-DEFICIENT CLUSTERS. Simoda, Mahiro (Goddard Inst. for Space Studies, New York. Tokyo Univ.); Iben, Icko Jr. Astrophys. J., Suppl. Ser.; 22: No. 183, 81-116(Sep 1970).

A more detailed account is presented of calculations concerning the hydrogen-burning phases of halo Population II stars. Evolutionary model results are given for (Z; X) = (10^{-3}; 0.65, 0.90, and 1.0) and ($\frac{2}{3} \times 10^{-4}$, 10^{-5}; 0.65, 0.80, and 1.0). Cox–Stewart opacity tables were employed. It is shown that apart from the well-known dependence on helium content, evolutionary tracks exhibit a significant dependence on Z, mainly through the abundances of the CNO elements, particularly the abundance of O. The CNO elements contribute to this dependence both through their role in the generation of nuclear energy and through their role in opacity. In view of the dominant importance of the CNO elements in effecting differences in the H–R diagram between metal-deficient clusters, the need for more reliable CNO abundance determinations is stressed and it is suggested that the CNO abundance should be regarded as a primary distinguishing parameter in cluster classification. Time-constant loci and theoretical luminosity functions are presented for all composition choices. On demanding a best fit in the H–R diagram between cluster loci and theoretical time-constant loci, ages ($t_9 > 25$) are found that are considerably larger than those ($t_9 \sim 10-18$) obtained by (a) fitting the cluster main sequence to Groombridge 1830 or (b) using the observed magnitude separation between RR Lyrae and cluster-turnoff stars in conjunction with theoretical–observational estimates of RR Lyrae magnitudes and theoretical–observational estimates of the initial helium content ($Y \sim 0.3$). It is suggested that the discrepancy may be substantially reduced by choosing an effective l/H that increases with decreasing surface temperature or by choosing a larger envelope opacity than that adopted. It is suggested further that if all clusters are of roughly the same age and helium content, then the turnoff luminosity for clusters with $Z \sim \frac{2}{3} \times 10^{-4}$ may be brighter by about 0.25 mag than that for clusters with $Z \sim 10^{-3}$; the effective temperature at turnoff may be higher, but the slope of the subgiant branch may be essentially the same. Evidence for and against the hypothesis of equal age and helium content for clusters is discussed. (auth)

51258 ANALYSIS OF THE STAR 15 UMa SHOWING METALLIC LINES BY THE METHOD OF DIFFERENTIAL GROWTH CURVES. Falipou, Marie-Agnes (Centre National de la Recherche Scientifique, Paris). Compt. Rend., Ser. B; 271: 305-8(27 Jul 1970). (In French).

The conclusions drawn from the analysis by the method of growth curves indicated that the star 15 UMa has all the characteristics of a classical Am star. (France)

51259 SPECTROSCOPIC BINARY HD 206874. Fisk, Robert S.; Abt, Helmut A. (Kitt Peak National Observatory, Tucson, Ariz.). Publ. Astron. Soc. Pac.; 81: 692-5(Oct 1969).

Tanner's suspicion that the original orbital period and eccentricity of this system are incorrect is confirmed, and new elements are derived. This system consists of two identical F2 IV stars probably rotating synchronously, but the system is probably not an eclipsing one. (auth)

51260 RS COLUMBAE, A NEW W URSAE MAJORIS SYSTEM. Bond, Howard E. (Louisiana State Univ. Observatory, Baton Rouge); Landolt, Arlo U. Publ. Astron. Soc. Pac.; 81: 696-9(Oct 1969).

Spectra and UBV photoelectric observations show that the variable star RS Columbae is a short-period eclipsing system, rather than a 14-day Cepheid. (auth)

51261 HELIUM-WEAK STARS. Jaschek, Mercedes; Jaschek, Carlos; Arnal, Marcelo (Observatorio Astronomico, La Plata). Publ. Astron. Soc. Pac.; 81: 650-6(Oct 1969).

A systematic survey was made for helium-weak stars and eight new objects were found. (auth)

51262 INVESTIGATION OF THE NH BANDS IN STELLAR SPECTRA. Schmitt, John L. (Univ. of Michigan, Ann Arbor. Kitt Peak National Observatory, Tucson, Ariz.). Publ. Astron. Soc. Pac.; 81: 657-64(Oct 1969).

The behavior of the NH bands at λ 3360 and λ 3370 in late-type stars was investigated. The technique used was visual inspection of spectrograms at 63 and 128 Å/mm. A plot of NH strength vs. spectral type for both normal and strong-CN stars indicated that the strong-CN stars have little or no enhancement of NH over the normal stars. Thus the abundance of nitrogen seems to be very nearly the same in the two classes of stars. (auth)

51263 RADIAL VELOCITIES OF V448 CYGNI. Cohen, Howard L. (Univ. of Florida, Gainesville). Publ. Astron. Soc. Pac.; 81: 665-71(Oct 1969).

Five spectrograms (63 Å/mm) of V448 Cygni, secured with the No. 1 36-inch telescope of the Kitt Peak National Observatory, were measured for radial velocity on a Grant profile comparator. The measured radial velocities of the B component fit the computed radial velocity curve of Petrie (1956) after the addition of a zero-point shift. However, the vague asymmetric lines of the O star make it difficult to make any meaningful measures of its motion. Hence, the mass ratio of V448 Cygni must be regarded as uncertain. (auth)

51264 POSTMAXIMUM SPECTRUM OF NOVA RS OPHIUCHI 1967. Wallerstein, George (Univ. of Washington, Seattle). Publ. Astron. Soc. Pac.; 81: 672-6(Oct 1969).

Measurements of spectrograms of RS Oph taken 110 days after the 1967 outburst are reported. Wavelengths, identifications, and intensities are presented. A continuum is present with a spectrophotometric gradient equivalent to that of a K0 star. Weak absorption lines confirm the presence of a cool source or a cool shell. The radial velocity of the emission lines is −47 km/sec and the absorption lines is −54 km/sec, neither of which differs greatly from velocities observed between outbursts. (auth)

51265 HYDROGEN-LINE EMISSION IN THE SPECTRUM OF U CEPHEI. Batten, A. H.; Laskarides, P. G. (Dominion Astrophysical Observatory, Ottawa). Publ. Astron. Soc. Pac.; 81: 677-84(Oct 1969).

Although all attempts to observe Hα emission in the spectrum of the eclipsing binary U Cephei during eclipse have so far failed, doubling of the hydrogen lines is observed in spectra obtained at quadratures. It is suggested that this is a partial filling of the absorption line by emission originating in the gaseous stream that flows from the cooler star to the hotter. (auth)

51266 MK CLASSIFICATION OF 142 VISUAL BINARIES. Christy, James W.; Walker, R. L. Jr. (Naval Observatory, Flagstaff, Ariz.). Publ. Astron. Soc. Pac.; 81: 643-9(Oct 1969).

MK classifications are presented for 142 visual binaries contained in A Catalog of Visual Binary Orbits (Worley 1963). The accuracy of the classification is discussed. (auth)

51267 SPECTROSCOPIC STUDIES OF SOUTHERN GALACTIC CLUSTERS. I. IC 2391. Perry, Charles L. (Louisiana State Univ. Observatory, Baton Rouge. Cerro Tololo Inter-American Observatory, La Serena, Chile); Bond, Howard E. Publ. Astron. Soc. Pac.; 81: 629-36(Oct 1969).

Radial velocities and MK spectral types are presented for twenty stars in the vicinity of the southern galactic cluster IC 2391. Two new single-line spectroscopic binaries (HD 75029 and HD 75105) and two suspected variable-velocity stars (HD 74340 and HD 75202) are noted. The question of cluster membership is reviewed on the basis of multicolor photometry, proper motions, radial velocities, and MK spectral types with the result that, of the forty-two stars in the photometric observing program, only nineteen stars were selected as certain cluster members. (auth)

51268 SPECTROSCOPIC OBSERVATIONS OF NOVA VULPECULA 1968 NO. 2. Stienon, F. M. (Case Western Reserve Univ., Cleveland). Publ. Astron. Soc. Pac.; 81: 613-18(Oct 1969).

Spectra of Nova Vulpecula 1968 No. 2 appear on two objective-prism plates taken with the 24-inch Burrell Schmidt of the Warner and Swasey Observatory. The gradient of the continuum radiation is the same for both spectra corresponding to a (B − V) color index of +1.3m. Near maximum light the rate of decay of the light curve predicts a photographic absolute magnitude of −9.6. With reasonable assumptions about the interstellar absorption, the distance of the nova is 7.6 kpc, about 250 pc above the plane of the Milky Way. (auth)

51269 STELLAR GROUPS IN OLD DISK POPULATION. Eggen, Olin J. Publ. Astron. Soc. Pac.; 81: 553-93(Oct 1969).

Topics discussed include: population definition; motions of the young disk stars; motions of old disk stars; color–luminosity array for the Wolf 630 group; spatial distribution of Wolf 630 group members; comparison of group parallaxes with other luminosity estimates; abundance and gravity effects in the ultraviolet; narrow-band infrared observations of the red stars; the 61 Cygni group; broad-band (R–I) observations of group members; masses of group binaries; and dynamics of the group stars. (W.D.M.)

51270 INFRARED SPECTRUM OF THE COOL DWARF WOLF 359. Wing, Robert F. (Ohio State Univ., Columbus. Ohio Wesleyan Univ., Delaware); Ford, W. Kent Jr. Publ. Astron. Soc. Pac.; 81: 527-9(Oct 1969).

The spectra of Wolf 359, Barnard's star, and several M giants were observed from 6,900 to 11,000 Å at a dispersion of 250 Å/mm. These spectra are compared and the molecules responsible are discussed. (W.D.M.)

51271 UNUSUAL DOUBLING OF MOLECULAR LINES IN THE SPECTRUM OF THE LONG-PERIOD VARIABLE STAR R LEPORIS. Phillips, John G.; Freedman, Richard S. (Univ. of California, Berkeley). Publ. Astron. Soc. Pac.; 81: 521-6 (Oct 1969).

During the course of a study of molecular bands in the spectra of carbon stars, attention was drawn to the distinctly anomalous appearance of the spectrum of the long-period variable star R Leporis. The spectrogram in question was taken on Sept. 26, 1964 when R Lep was near maximum light. The doubling of the molecular lines and the structure of the Hα suggests strongly that the atmosphere of R Lep consists of two layers with differential radial velocity of 20 km/sec, corresponding to the doublet splitting of 0.4 Å. (W.D.M.)

51272 INTERSTELLAR MATTER IN THE REGION OF THE PERSEUS II ASSOCIATION. Lynds, Beverly T. (Univ. of Arizona, Tucson). Publ. Astron. Soc. Pac.; 81: 496-520(Oct 1969).

Observational data are assembled and discussed in order to determine the distribution of the interstellar gas and dust in the direction of the Per II association. It is concluded that most of the obscuration occurs in dark foreground clouds of variable opacities. Only one or two of the 17 Per II cluster members appear to lie in dark nebulae. It also appears that the interstellar gaseous component may be located in an extensive foreground layer. The emission nebula NGC 1499 is considered to be a rim of a foreground dark nebula which is illuminated by the O7 star ξ Per. The electron densities within NGC 1499 are believed to be greater than 10 and less than 100 cm^{-3} with the possible exception of the brightest rim within the emission nebula. On the basis of the absence of detectable emission in the immediate vicinity of ξ Per, it is argued that the value of the electron density between NGC 1499 and ξ Per must be very low, probably less than 5 cm^{-3}. (auth)

51273 PHOTOELECTRIC PHOTOMETRY FROM A SPACE VEHICLE. Code, Arthur D. (Univ. of Wisconsin, Madison). Publ. Astron. Soc. Pac.; 81: 475-87(Oct 1969).

The nature of the OAO instrumentation and operation procedure is briefly described, and the type of data and the kinds of investigations that are being carried out with this spacecraft are indicated. (W.D.M.)

51274 VISUAL DOUBLE HR 3817 AND 3 CENTAURI A. Thackeray, A. D. (Radcliffe Observatory, Pretoria). Observatory; 89: 235-6(Dec 1969).

Jaschek and Aguilar's (1969) discovery of peculiar lines in HR 3817 was confirmed, especially for λ 3984 Å, but they were more diffuse and weaker than in 3 Cen A. The peculiarities were seen more clearly in Radcliffe spectra of the fainter component of the visual double. There was no sign of ^{3}He in the brighter component. (W.D.M.)

51275 OSMIUM LINES IN THE SPECTRUM OF THE PECULIAR A STAR 73 DRACONIS. Guthrie, B. N. G. (Royal Observatory, Edinburgh). Observatory; 89: 224-6(Dec 1969).

A preliminary study was made of the peculiar A-type spectrum variable 73 Dra, using three Mount Palomar spectra. About 90% of the lines from 4000 to 4830 Å were identified. As the spectra were very rich in lines of Ti, Cr, Mn, and Fe, the detection of unusual elements was difficult. However, definite evidence is given for the presence of osmium. (W.D.M.)

51276 SUPERNOVA REMNANTS AND THE GALACTIC MAGNETIC FIELD. Shaver, P. A. (Univ. of Sydney). Observatory; 89: 227-30(Dec 1969).

A preliminary statistical study of the distribution of radio emission from shell structures in supernova remnants is presented. The average ring profile was determined for 18 remnants. (W.D.M.)

51277 METALLIC-LINE STARS. Conti, Peter S. (Univ. of Utrecht). Publ. Astron. Soc. Pac.; 82: 781-808(Aug 1970).

A review is presented on metallic-line stars in which an attempt is made to justify the following definition: The Am phenomenon is present in stars that have an apparent surface underabundance of Ca (and/or Sc) and/or an apparent overabundance of the Fe group and heavier elements. (W.D.M.)

51278 FREQUENCY OF SPECTROSCOPIC BINARIES. Jaschek, Carlos; Gomez, Ana E. (Observatorio Astronomico, La Plata). Publ. Astron. Soc. Pac.; 82: 809-14(Aug 1970).

A discussion of the observed dispersion of radial velocity measurements shows that the percentage of spectroscopic binaries is constant along the main sequence and that it is smaller for giants. (auth)

51279 EFFECTS OF SMALL ORBITAL ECCENTRICITY ON THE DERIVED ELEMENTS OF ECLIPSING SYSTEMS. Wilson, Robert E. (Univ. of South Florida, Tampa). Publ. Astron. Soc. Pac.; 82: 815-20(Aug 1970).

The effects of small orbital eccentricity on the solutions of eclipsing binary light curves were investigated by comparing nomographically the solutions of circular orbits with similar orbits of small eccentricity. This study indicated that individual cases should be examined before assuming that the errors resulting from a circular orbit solution will be negligible. (auth)

51280 SPECTROSCOPY OF STARS IN THE GALACTIC CLUSTER NGC 1039 (M34). Ianna, Philip A. (Ohio State Univ., Columbus). Publ. Astron. Soc. Pac.; 82: 825-9(Aug 1970).

Spectroscopic data for the brighter stars in the vicinity of NGC 1039 are presented. Three new peculiar A stars, including a manganese star, were identified and may be members of the cluster. The mean v sin i of ten cluster members of spectral type B8 V to A0 V is larger than for field stars of similar spectral type. (auth)

51281 BD–6°4932: A NEW DELTA SCUTI VARIABLE. Hall, Douglas S.; Mallama, Anthony D. (Vanderbilt Univ.). Publ. Astron. Soc. Pac.; 82: 830-6(Aug 1970).

Photoelectric observations are presented for BD–6° 4932, a newly discovered variable star in optical coincidence with M 11. The period seems not to be constant, but a characteristic value is 0.2 ± 0.05d. The variable is of the δ Set type and is remarkably similar to the giant star ρ Pup. (auth)

51282 HEAVY ELEMENTS IN Ap STARS. Brandi, E.; Jaschek, M. (Observatorio Astronomico, La Plata). Publ. Astron. Soc. Pac.; 82: 847-50(Aug 1970).

The presence of heavy elements was investigated in twelve late Ap stars. In five of them osmium and platinum were found. In several stars there are also present lines whose only possible identification is ionized uranium. (auth)

51283 RY SAGITTARII. Eggen, Olin J. (Australian National Univ., Canberra). Publ. Astron. Soc. Pac.; 82: 851-6 (Aug 1970).

(UBVRI) observations obtained in 1969 are given for RY Sgr. A reddening of E(B–V) = +0.11m was determined from nearby stars of early type. A comparison with similar observations of W Men in the Large Magellanic Cloud showed the latter to be a considerably hotter star. There is no convincing evidence against the conclusion that RY Sgr, like R CrB, is an old disk object with a luminosity near M_V = –3.5m. (auth)

51284 WIDTHS OF CA II CHROMOSPHERIC EMISSION LINES AS A MEASURE OF STELLAR LUMINOSITY. Wilson, Olin C. (Carnegie Inst. of Washington, D. C. California Inst. of Tech., Pasadena). Publ. Astron. Soc. Pac.; 82: 865-77(Aug 1970).

The background of the Ca II emission-line-width method of deriving M_v is reviewed. Calibration procedures are discussed, including the implications dependent upon the close agreement obtained from the MK standards, the Sun–Hyades, and trigonometric parallaxes. A brief discussion of the possible effects of metal abundance is included. (auth)

51285 LIST OF Ap STARS THAT MAY HAVE LONG PERIODS. Preston, George W. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Publ. Astron. Soc. Pac.; 82: 878-82(Aug 1970).

A list of Sr–Cr–Eu stars with v sin i < 10 km sec^{-1} is given. It is suggested that UBV and spectroscopic observations made on appropriate time scales will lead to the discovery of long periods for some of these stars. (auth)

51286 SPECTROPHOTOMETRY OF OMICRON CETI. Odell, Andrew P.; Vrba, Frederick J.; Fix, John D.; Neff, John S. (Univ.

of Iowa, Iowa City). Publ. Astron. Soc. Pac.; 82: 883-8(Aug 1970).

Spectrophotometric observations of *o* Ceti (Mira) were obtained on twelve nights just before, during, and just after the 1969 maximum. The spectrum of *o* Ceti was fcund to undergo major changes during the period of the observations. The equivalent widths of the TiO band at 4960 Å and Hγ and Hδ emission lines of hydrogen were found to be highly variable. The time variations of these features do not seem to be strongly correlated with the visual light curve. (auth)

51287 UBV PHOTOMETRY OF NOVA (HR, DELPHINI 1967. Barnes, Thomas G.; Evans, Nancy Remage (Univ. of Toronto). Publ. Astron. Soc. Pac.; 82: 889-93(Aug 1970).

Photoelectric UBV observations of HR Delphini were made at the David Dunlap Observatory during 1967 and 1968. Preliminary results for the earliest data have already been reported by Barnes et al. (1967). Results are presented for the entire series of observations, as well as new values for the prenova magnitudes. (W.D.M.)

51288 NGC 1058 AND ITS PECULIAR SUPERNOVA. Bertola, Francesco (Univ., Padua); Arp, Halton. Publ. Astron. Soc. Pac.; 82: 894-7(Aug 1970).

Deep photography done on the spiral galaxy NGC 1058 in 1968 and 1970 is reported. The plates were taken at the prime focus of the 200-inch telescope and are listed. The magnitude of the supernova in NGC 1058, was discovered by Wild in 1961, was visually estimated from these plates and is recorded. The observations show that the supernova is still visible, although now much fainter, at a level somewhere between 21 and 22 m. (W.D.M.)

51289 LITHIUM IN C AND CS STARS. Warner, Brian; Dean, Charles A. (Univ. of Texas, Austin). Publ. Astron. Soc. Pac.; 82: 904-8(Aug 1970).

To increase the number of accurate spectral classifications and measured radial velocities for carbon and related stars, spectra are being obtained at 50 and 100 Å/mm. From a preliminary study of the spectra obtained so far, visual estimates of the strength of the λ6707 Li line are reported. (W.D.M.)

51290 APPEARANCE OF NGC 7662 IN THE LIGHT OF He I λ 10830. Vaughan, Arthur H. Jr. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Publ. Astron. Soc. Pac.; 82: 910-13(Aug 1970).

A direct photograph shows that the features present at λ 10830 are essentially those seen in He I λ 4471, although they appear somewhat less sharply defined at the optically thick wavelength. The interpretation of this effect as the result of scattering or as a population effect in the collisionally excited λ 10830 line is discussed briefly. (auth)

51291 OPTICAL RADIAL VELOCITY FOR NGC 6857. Bohuski, Thomas J. (Univ. of Texas, Austin); Rubin, Robert H.; Smith, Malcolm G. Publ. Astron. Soc. Pac.; 82: 913-16(Aug 1970).

An optical radial velocity is obtained for NGC 6857 from an Hα line profile and is found to differ somewhat from the radial velocity obtained from radio recombination lines, whose velocity is predominantly representative of the object K3-50, which is one minute of arc north of NGC 6857. (auth)

51292 ECLIPSING VARIABLE NEAR THE MAGELLANIC CLOUD CLUSTER NGC 1783. Graham, J. A. (Cerro Tololo Inter-American Observatory, La Serena, Chile). Publ. Astron. Soc. Pac.; 82: 918-21(Aug 1970).

A new eclipsing variable with period 0.959 or 1.918d was found near the cluster NGC 1783 in the Large Magellanic Cloud. (auth)

51293 INTEGRATED COLOR INDICES OF M67 AND NGC 188. Goodenough, D. C.; Hartwick, F. D. A. (Victoria Univ., Toronto). Publ. Astron. Soc. Pac.; 82: 921-3(Aug 1970).

The integrated color indices of clusters within the Galaxy are important quantities because they allow comparisons to be made with clusters in more distant galaxies where it is either impractical or impossible to observe individual stars within these clusters. In this note the integrated color indices (B−V) and (U−B) and the reddening-free index Q = (U−B) −0.72(B−V) for the old galactic clusters M67 and NGC 188 are determined. (W.D.M.)

51294 SPECTROSCOPIC OBSERVATIONS OF HBV 475 AND Z ANDROMEDAE. Dean, Charles E.; van Citters, Wayne (Univ. of Texas, Austin). Publ. Astron. Soc. Pac.; 82: 924-7(Aug 1970).

The spectra of HBV 475 and Z Andromedae are compared, and the relationship between HBV 475 and V1016 Cygni is discussed. (auth)

51295 SPECTRAL DISTRIBUTION OF INFRARED OBJECTS AND RELATED STARS. Maihara, Toshinori (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 44: 99-109(Jul 1970).

The spectra of infrared stars and the anomalous excess emissions in the infrared region of T Tauri stars or some red giant stars are interpreted by an effect of circumstellar dust clouds. A probable model of dust stars is calculated, assuming the distribution of dust particles in the circumstellar space and including absorption, scattering, and thermal re-emission processes. It is seen that the spectra calculated by the use of a rather simple model of the circumstellar dust envelope will fit the infrared spectra observed so far by photometric measurements. (auth)

51296 REMARKS ON QUARK STARS. Ivanenko, D.; Kurdgelaidze, D. F. (Moscow State Univ.). Indian J. Pure Appl. Phys.; 7: 585-6(Sep 1969).

Properties of a quarkian substance are investigated. For densities much greater than 10^{43} cm^{-1}, one can expect a mixture of baryons and quarks. It is shown that, for sufficiently high densities, quarkian matter can go into the superconducting state. (auth)

51297 PROBLEMS IN THE FORMATION OF NEUTRAL HELIUM LINES IN EARLY TYPE STARS. Simpson, R. W. (Queensland Univ., Brisbane). Proc. Astron. Soc. Aust.; 1: 326-8(Apr 1970).

Assumptions that have been made in calculating line profiles and equivalent widths of neutral He lines, were investigated. The effect of electron scattering on the continuum flux was considered, and a curve of growth analysis carried out to study the effect. Theories involved in calculating the line absorption coefficient were also investigated. (Australia)

51298 OH EMISSION FROM PROTOSTARS. Johnston, I. D. (Sydney Univ.). Proc. Astron. Soc. Aust.; 1: 336-7(Apr 1970).

Maser action resulting from population inversion due to the non-equilibrium situation as proposed in the electron-pumping model, is thought to duplicate most of the observed features of class I sources. This equilibrium is expected to exist in protostars. (Australia)

51299 SMOOTHING MECHANISM OF THE ODD-EVEN STRUCTURE OF ELEMENTAL ABUNDANCE CURVE. Ohnishi, Teruaki; Nishi, Tomota (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 43: 558-9(Feb 1970).

It is proposed that an additional type of r process takes place in the carbon-burning shell of supernovae or later-stage stars, where carbon flash may occur, at higher temperature and density than the ones generally accepted. This process produces nuclides having a smaller odd−even effect with regard to mass number, and these nuclides contribute to the smoothing of the odd−even structure in the abundance curve of r-process nuclides in the Universe. This smoothing of the elemental abundance curve is due to two effects. One is the smoothing-out of isotopic ratio with increase of the surrounding density; this can be seen from the nuclear Saha's equation, according to which the isotopic ratio approaches unity at high density. The other is the smoothing caused by the temperature-dependent pairing energy of nucleons, which appears in any mass formula and which decreases with increasing temperature. (R.W.R.)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstract 51361.

51300 (AD-706078) CELESTIAL X-RAY SOURCES. Final Scientific Report. Tucker, Wallace H. (American Science and Engineering, Inc., Cambridge, Mass.). 15 Apr 1970. Contract F44620-67-C-0065. 20p. NTIS.

Work in the following general areas is described: (1) synchrotron models for x-ray sources, (2) the interaction of the high-frequency radiation from x-ray sources with contiguous matter, (3) the secular behavior of the luminosity of x-ray sources, (4) the physical conditions in the pulsating x-ray source in the Crab Nebula, and (5) miscellaneous related topics. A bibliography of all work performed under the contract is given. (auth) (USGRDR)

51301 (AD-706311) MEASUREMENT OF THE DEFLECTION OF 9.602-GHz RADIATION FROM 3C279 IN THE SOLAR GRAVITATIONAL FIELD. Seielstad, G. A.; Sramek, R. A.; Weiler, K. W. (Owens Valley Radio Observatory, Pasadena, Calif.). 1970. Contract N00014-67-A-0094-0008. 17p. NTIS.

During its occultation by the Sun in October 1969, the position of the radio source 3C 279 was interferometrically monitored to determine the deviation of its 9.602-GHz radiation in the solar gravitational field. Rapid instrumental calibration and negligible coronal diffraction enabled the measurement of a general relativity deflection of 1.77 ± 0.20 seconds at the limb of the Sun. This is in close agreement with Einstein's prediction. (auth) (USGRDR)

51302 (CSIRO-Trans-10208) PLACE OF QUASARS AMONG METAGALACTIC POPULATIONS. Ozernoi, L. M. Translated by M. A. Hintze (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia), from Astron. Tsirk.; No. 469, 1-4(28 Apr 1968). 5p. Dep. NTIS (U. S. Sales Only).

The characteristics of quasars (QSS) and quasags (QSG) are compared with other metagalactic formations. An evolutionary sequence, qualitatively indicating order of increasing concentration of matter towards galactic center was determined as: -Ir-S-E-D-(BCG-N-QSG)-QSS. A similar sequence of increasing radio luminosities (L-sequence) within the range 10^7 to 10^{11} Hz was plotted as:- Ir-S-(E-D)-N-QSS. No noticeable radio emission was obtained from BCG and QSG. The fraction of nonthermal component in total emission increases from n ≈ 0 to n ≈ 1 in the L sequence, where the contribution of stars to emission becomes negligibly small. (Australia)

51303 (CSIRO-Trans-10245) QUASARS ARE STELLAR SYSTEMS. Kurochkin, N. E. Translated by M. Hintze (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia), from Astron. Tsirk.; No. 496, 3-7(28 Feb 1969). 5p. Dep. NTIS (U. S. Sales Only).

Composite spectra of quasars 3C 273, 3C 48, 3C 245, 3C 446, and 3C 9 were constructed, assuming they were of stellar nature. (Australia)

51304 INTERPRETATION OF RADIO RECOMBINATION LINES EMITTED BY GALACTIC NEBULAE. Hoang-Binh, D. (Observatoire de Paris, Meudon, France). Astrophys. Lett.; 6: 151-4(Sep 1970).

The role of the emission measure in a theoretical determination of the electron temperature from radio recombination lines is discussed. (auth)

51305 ENERGY PRODUCTION IN FOUR EXTRAGALACTIC RADIO SOURCES. Mitton, Simon (Mullard Radio Astronomy Observatory, Cambridge, Eng.). Astrophys. Lett.; 6: 161-6 (Sep 1970).

Four extragalactic radio sources were mapped at 5 GHz with a resolution of 6.5 × 6.5 cosec δ arc sec. Three of the sources, 3C 47, 249.1 and 263, are associated with quasi-stellar objects and have widely separated radio components, but for the latter two sources radio emission was also detected from the quasi-stellar objects themselves. Triple structure was also found for the unidentified source 3C 111, which has a compact central component having a relatively flat spectrum. Tables are presented with the basic observational data and physical parameters derived from the observations. The production of energy over long periods of time in these sources is discussed. (auth)

51306 ASTRONOMICAL MEASUREMENT OF THE 18-cm OH TRANSITION FREQUENCIES. Manchester, R. N.; Gordon, M. A. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astrophys. Lett.; 6: 243-6(Oct 1970).

Relative transition frequencies of the four ground-state electric dipole transitions and absolute transition frequencies of the two magnetic dipole transitions for the $O^{16}H$ molecule were determined by astronomical observations of OH absorption sources. They differ from frequencies conventionally used to date. (auth)

51307 OBSERVATIONS OF INTERSTELLAR ^{18}OH. Wilson, W. J.; Barrett, A. H. (Massachusetts Inst. of Tech., Cambridge). Astrophys. Lett.; 6: 231-6(Oct 1970).

Absorption measurements were made of $O^{18}H$ against the galactic center (Sgr A), and both the F = 1 → 1 (1637 MHz) and the F = 2 → 2 (1639 MHz) lines were detected. The frequencies of these lines were accurately measured and an estimate of the $O^{17}H/O^{16}H$ abundance ratio was made. The ratio of $O^{18}H/O^{16}H$ in the galactic center was derived as 1:390, which is near the terrestrial value of 1:490. Also, a search for $O^{18}H$ in emission from the strong $O^{16}H$ emission sources W3 and W49 was made. The results of this search were negative with an upper limit to the $O^{18}H/O^{16}H$ emission ratio of 1/2000 to 1/3000. (auth)

51308 PULSARS AND COSMIC RAYS. Apparao, Krishna M. V.; Rengarajan, T. N. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Lett.; 6: 229-30(Oct 1970).

From a consideration of the absorption of high-energy particle radiation near young pulsars and the associated supernova remnants, it is argued that pulsars may not contribute effectively to high-energy cosmic radiation. (auth)

51309 X-RAY SPECTRUM OF THE CRAB NEBULA BETWEEN 20 keV AND 3 MeV. Daju, S.; Hillier, R. R.; Janes, A. F.; Redfern, R. M. (Univ. of Bristol, Eng.). Astrophys. Lett.; 6: 225-7(Oct 1970).

The x-ray spectrum from the Crab Nebula was measured between 20 keV and 130 keV and an upper limit to the flux between 300 keV and 3 MeV was obtained. The relationship between the spectrum of the steady flux from the nebula and the spectrum of the pulsed emission is discussed. (auth)

51310 OBSERVATIONS OF EXTRAGALACTIC RADIO SOURCES HAVING UNUSUAL SPECTRA. Blake, G. M. (Mullard Radio Astronomy Observatory, Cambridge, Eng.). Astrophys. Lett.; 6: 201-5(Oct 1970).

Observations are reported of twelve radio sources whose spectra show a well defined maximum flux density. The optical identifications of these sources suggest that the majority of peaked spectra sources are associated with quasars or the nuclei of Seyfert galaxies. (auth)

51311 RADIO EMISSION FROM OPTICAL QUASI-STELLAR OBJECTS. Mills, B. Y.; Little, A. G. (Univ. of Sydney). Astrophys. Lett.; 6: 197-9(Oct 1970).

Observations at 408 MHz of 25 blue stellar objects reveal a sharp distinction between those originally discovered by optical and radio means. Only the latter could be positively identified with radio sources. Radio emission from the "optical" objects could not be detected at a level of 0.1 flux unit, more than an order of magnitude fainter than the identified radio sources. (auth)

51312 REVISED IDENTIFICATION OF THE RADIO SOURCE OQ 208. Blake, G. M. (Mullard Radio Astronomy Observatory, Cambridge, Eng.); Argue, A. N.; Kenworthy, C. M. Astrophys. Lett.; 6: 167-8(Sep 1970).

The radio source OQ 208, previously identified with a stellar object, has been found to coincide with the nucleus of a Seyfert galaxy. (auth)

51313 PULSE BROADENING OF PSR 0833-45 BY INTERSTELLAR SCATTERING. Ables, J. G. (CSIRO, Sydney); Komesaroff, M. M.; Hamilton, P. A. Astrophys. Lett.; 6: 147-50 (Sep 1970).

It is shown that scattering by electron density inhomogeneities in the interstellar medium can explain the very marked increase in pulse duration of PSR 0833-45 which can be observed at long wavelengths. (auth)

51314 TECHNIQUE FOR RECORDING PHASE-RESOLVED SPECTRA OF REGULARLY VARYING FAINT LIGHT SOURCES. Powell, J. R.; Trumbo, D. E.; Lynds, C. R. (Kitt Peak National Observatory, Tucson, Ariz.). Publ. Astron. Soc. Pac.; 81: 601-7(Oct 1969).

A technique was developed for recording phase-resolved spectra of regularly-varying faint light sources. The shortcomings of this technique were investigated. The method was used to record phase-resolved spectra of the Crab Nebula pulsar. (auth)

51315 USE OF METHOD OF STATISTICAL ESTIMATIONS IN RADIOASTRONOMICAL MEASUREMENTS OF DISCRETE SOURCE INTENSITIES. Sodin, L. G. (Inst. of Radiophysics and Electronics, Kharkov). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 670-7(1970). (In Russian).

The optimal determination of the intensity of the point source of cosmic radio emission in the presence of additive and multiplicative noises in the input of a radiometer with a given hf transmission band is considered. The radiation pattern of the radio telescope is assumed to be known exactly. (auth)

51316 GALACTIC SOURCES IN THE 4C CATALOGUE. Caswell, J. L. (Dominion Radio Astrophysical Observatory, Penticton, B. C.). Observatory; 89: 230-4(Dec 1969).

A comparison of the spatial density of 4C radio sources at high and low galactic latitudes shows that, of the 103 4C sources with $|b^{II}| < 1°$, about 30 are probably galactic. Investigation of the individual sources responsible for the increased spatial density shows that the excess can be accounted for mainly by high-brightness features in extended supernova remnants. (auth)

51317 TON 202, A QUASI STELLAR RADIO SOURCE. Greenstein, Jesse L.; Oke, J. B. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Publ. Astron. Soc. Pac.; 82: 898-903(Aug 1970).

The mean results of observations on three nights with a multichannel spectrometer are shown. It is concluded that Ton 202 is a quasi-stellar radio source, not excessively bright, and seems unusual mainly in the large width of λ2798 of Mg II. (W.D.M.)

51318 PULSAR EMISSION MECHANISMS. Tsytovich, V. N. (St. Catherine's Coll., Oxford); Buckee, J. W.; Ter Haar, D. Phys. Lett.; 32A: 471-2(7 Sep 1970).

By using the available data on the Crab pulsar, it is suggested that none of the pulsars so far observed, except the Crab and, possibly, the Vela pulsar, will show optical pulses. Some possible physical processes in the pulsar magnetosphere that may lead to the short-period pulsation are discussed. (auth)

51319 18-CM OBSERVATIONS OF GALACTIC OH FROM LONGITUDES 305° TO 334°. Goss, W. M.; Manchester, R. N.; Robinson, B. J. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Aust. J. Phys.; 23: 559-73(Aug 1970).

Observations were made of 18-cm OH emission and absorption for four sources between galactic longitudes 305 and 334°. A new type of OH emission is associated with G331.5-0.1. Absorption was found in another two sources. The four Stokes parameters of the OH emission were measured. The relationship of the OH to the H II regions was investigated by position measurements and from a comparison of OH and recombination line radial velocities. (auth) (Australia)

51320 RADIO SKY BACKGROUND STUDIES USING THE MOON AS A SCREEN. Stankevich, K. S. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia); Wielebinski, R.; Wilson, W. E. Aust. J. Phys.; 23: 529-39(Aug 1970).

The Moon is a celestial object of well-defined temperature and size that, in its passage through the Galaxy, screens various areas of galactic emission. Measurements of the background temperature using the Moon as a screen were made at 408 and 635 MHz with the 210-ft radio telescope at Parkes. The measurements required the determination of accurate temperature differences at both frequencies and of an absolute beam temperature at a selected calibration point. The results indicated small-scale spectral variations in the vicinity of the galactic plane. A new upper limit is set on the intensity of emission that may originate in an ionized intergalactic plasma at decimeter wavelengths. (auth) (Australia)

51321 SECONDARY PERIODICITIES IN FOUR STRONG PULSARS AT 80 MHz. Sise, O. B.; Mulhall, P. S. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Proc. Astron. Soc. Aust.; 1: 322-4(Apr 1970).

Intensity variations were studied at 80 MHz in pulsars CP 0834, 0950, 1133, 1919. Apart from CP 0950 the power spectra of each pulsar, indicated secondary periodicities. (Australia)

51322 80 MHz OBSERVATIONS OF THE CORONAL BROADENING OF THE CRAB NEBULA. Harries, J. R.; Blesing, R. G.; Dennison, P. A. (Adelaide Univ.). Proc. Astron. Soc. Aust.; 1: 319-20(Apr 1970).

Preliminary results are presented of observations during June 1969 of the coronal broadening of the Crab Nebula. The degree of broadening and the size and orientation of the resulting image gave information about the irregularities in electron density in the corona. (Australia)

51323 USE OF H I ABSORPTION TO DETERMINE DISTANCE TO 10 GALACTIC RADIO SOURCES. Goss, W. M.; Murray, J. D.; Radhakrishnan, V. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Proc. Astron. Soc. Aust.; 1: 332-3(Apr 1970).

The distances of eight sources having galactic longitudes within 90° of the galactic center, and two outside this range are tabulated from results gained at a Parkes observatory H I absorption survey. Results are compared with kinematic distances estimated from recombination line (H109α) data. (Australia)

51324 SUPERNOVA REMNANTS, PULSARS, AND X-RAY SOURCES. Milne, D. K. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Proc. Astron. Soc. Aust.; 1: 333-4(Apr 1970).

The distribution of supernova remnants in the galactic plane, and the possible association of these objects with pulsars and x-rays sources, are discussed. (Australia)

51325 MEASUREMENTS OF OH IN SAGITTARIUS A AND B2. McGee, R. X.; Gardner, F. F.; Sinclair, M. W. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Proc. Astron. Soc. Aust.; 1: 334-6(Apr 1970).

The absorption spectra of the two principal lines of ^{18}OH at 1637 and 1639 MHz, approximately in the directions of sources Sgr A and Sgr B2, were measured. Optical depth estimations enabled calculations of the $^{18}OH/^{16}OH$ and the $^{18}OH/H$ ratios. (Australia)

51326 EXTRAGALACTIC RADIO SOURCES WITH EXTENDED STRUCTURE. Schilizzi, R. T.; McAdam, W. B. (Sydney Univ.). Proc. Astron. Soc. Aust.; 1: 337-40(Apr 1970).

The bright southern sources, 0336-35, 0511-30, 0634-20, and 0800-09 are described by a two-component model, and the source 1332-33 is mapped as a triple structure inside an extended arc. (Australia)

51327 MOLONGLO CATALOGUE SURVEY. Davies, I. M. (Sydney Univ.). Proc. Astron. Soc. Aust.; 1: 340-1(Apr 1970).

Progress in the compilation of a catalog of radio sources complete to minimum flux density level, tentatively chosen as 0.2 f.u., carried out at the Molonglo one-mile cross to December 1969, is reviewed. A map of the area surveyed to date is shown, together with an example of analog output and corresponding record. (Australia)

51328 FREQUENCY DEPENDENCE OF 4C SOURCE POSITIONS. Munro, R. E. B.; Hopkins, D. G. (Sydney Univ.). Proc. Astron. Soc. Aust.; 1: 341-4(Apr 1970).

Comparison of the positions of 4C catalog sources measured at 408 and 2700 MHz was made to investigate the frequency dependence of the positions. Of 120 sources analyzed at these frequencies, 22 have positional discrepancies greater than 45″. The position differences, flux densities, and optical identifications of 17 of these are tabulated. (Australia)

51329 OBSERVATIONS OF CENTAURUS A AT 80 MHz. Lockhart, I. A. (Australian National Univ., Canberra); Sheridan, K. V. Proc. Astron. Soc. Aust.; 1: 344-5(Apr 1970).

Observations made with the Culgoora radioheliograph at 80 MHz, of the compact central components of source Centaurus A, associated with NGC 5128, are presented. Contour maps, intensity ratio, component separation, position angle, right ascension, declination, and integrated flux density were derived. (Australia)

51330 BALLOON OBSERVATIONS OF A NEW-BORN X-RAY SOURCE. Thomas, R. M.; Buselli, G.; Clancy, M. C.; Davison, P. J. N. (Adelaide Univ.). Proc. Astron. Soc. Aust.; 1: 345-7(Apr 1970).

Results are presented of the monitoring of an x-ray source at 3 to 12 keV in a position estimated as $\alpha_{1950} = 14\text{ h }57\text{m} \pm 6\text{m}$; $\delta_{1950} = -30.7° \pm 3°$, $l^{II} = 333°$; $b^{II} = +24°$. (Australia)

51331 POLARIZATION OF THE 18cm OH EMISSION. Bromley, A. G. (Sydney Univ.). Proc. Astron. Soc. Aust.; 1: 347-8(Apr 1970).

Simplified analyses performed showed that simple pumping mechanisms may lead to a wide variety of observable distributions of the radiation among the various frequencies. Results are of a general nature, and ignore the question of polarization. (Australia)

51332 SYNCHROTRON RADIATION FROM MILDLY RELATIVISTIC ELECTRONS. Wild, J. P. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Proc. Astron. Soc. Aust.; 1: 348-50(Apr 1970).

Approximate formulas are derived that are applicable to mildly relativistic electrons, especially those with velocity βc such that $0 \ll \beta \lesssim 0.9$. These approximations are also relevant to the case of highly relativistic electrons in a plasma with refractive index appreciably less than unity. (Australia)

Solar Phenomena

Refer also to abstract 51514.

51333 (AD-706072) CORRELATION OF X-RAY RADIATION (2 TO 12 A) WITH MICROWAVE RADIATION (10.7 cm) FROM THE NON-FLARING SUN. Progress Report. Gibson, Jean; Van Allen, James A. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Apr 1970. Contract N00014-68-A-0196-0003. 40p. NTIS.

Supersedes AD-701716.

An extended, homogeneous body of solar x-ray observations (2 to 12 A) from equipment on Explorer 33 and Explorer 35 for 734 days during the period July 1, 1966 to Dec. 25, 1968 and the 10.7-cm daily solar radio flux values of the Algonquin Radio Observatory were used to establish the relationship between daily average values of the x-ray and radio fluxes from the whole disc of the nonflaring Sun and to consider the significance of this relationship. (USGRDR)

51334 (AD-707123) INVESTIGATIONS OF THE DYNAMICS OF IONIZED AND NEUTRAL ATMOSPHERES. Final Report, June 1, 1967–December 31, 1969. Starr, Victor P. (Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology). 31 Jan 1970. Contract F19628-67-C-0229. 188p. (AFCRL-70-146). NTIS.

The aim of solar studies at M.I.T. is to render aid in the prediction of solar activity and its effects in the ionosphere and contiguous regions inside and outside of the terrestrial atmosphere. The general circulation of the outer layers of the Sun creates areas of disturbance, mainly the active regions, which contain various manifestations such as sunspots, flares, other magnetic phenomena, and, notably, emanations to space. These emanations propagate through the region between the Sun and the Earth and, in addition to radiation, contain particle emissions, shock waves in the solar wind, and associated magnetic effects. These propagations strike the terrestrial atmosphere and produce various important manifestations such as aurorae and kindred effects in the ionosphere, disturbances in the Earth's magnetic field, and changes in the trapped energy in the Van Allen belts. The program of studies at M.I.T. has aimed at the comprehensive investigation of all links in this chain of effects. The phase of the effort described in this final report deals with the relationship of the solar general circulation and the development of active regions. (auth) (USGRDR)

51335 (AD-708723) SOLAR RADIO STUDIES AT MANILA OBSERVATORY. Final Report, May 15, 1967–May 14, 1970. Badillo, Victor L. (Manila Observatory (Philippines)). 30 May 1970. Contract F19628-67-C-0300. 28p. (AFCRL-70-358). NTIS.

The work performed at Manila Observatory in the period 1967 to 1970 is summarized, the peak of solar cycle 20. A solar radio patrol was maintained with six single-frequency radiometers (8800, 4995, 2695, 1415, 606, and 245 MHz) and a 24- to 48-MHz swept-frequency interferometer radiometer. During this active period, ten proton flares were recorded, and detailed radio-optical studies made of some of them. The latest proton flare, Mar. 29, 1970, is discussed. A list and abstracts of publications or completed papers are provided. (auth)

51336 (AD-709073) COMPARISON OF THE MEAN PHOTOSPHERIC MAGNETIC FIELD AND THE INTERPLANETARY MAGNETIC FIELD. Severny, A.; Wilcox, J. M.; Scherrer, P. H.; Colburn, D. S. (California Univ., Berkeley. Space Sciences Lab.). 5 May 1970. Contract N00014-69-A-0200-1016. 24p. NTIS.

The mean photospheric magnetic field of the Sun seen as a star was compared with the interplanetary magnetic field observed with spacecraft near the Earth. Each change in polarity of the mean solar field is followed about 4½ days later by a change in polarity of the interplanetary field (sector boundary). The scaling of the field magnitude from Sun to near Earth is within a factor of two of the theoretical value, indicating that large areas on the Sun have the same predominant polarity as that of the interplanetary sector pattern. An independent determination of the accuracy of the solar magnetograph yielded a value of 0.1 ± 0.05 gauss. An effect attributed to a delay of approximately one solar rotation between the appearance of a new photospheric magnetic feature and the resulting change in the interplanetary field is observed. The present results appear to be consistent with previous investigations. (auth) (USGRDR)

51337 (AD-806442) EVALUATION OF THE RADIATION HAZARD DUE TO SOLAR-PARTICLE EVENTS. Webber, W. R.; Benbrook, J. R.; Thomas, J. R.; Hunting, Al; Duncan, Richard (Boeing Co., Seattle, Wash. Aerospace Group). Dec 1963. 109p. (D-2-90469). NTIS.

Supersedes reports D-2-11608; AD-606548.

A comprehensive treatment of the current knowledge of solar-particle events is presented. A qualitative description is given of the various methods of detecting solar-particle events, and all of the pertinent data available are tabulated. The characteristics of each of the events were determined and from these, the intensities and the characteristic rigidities were estimated for each event. Based upon this information, the radiation doses were calculated for each event and cumulative dose-probability curves were derived. Comments are included regarding missions in solar cycle 20 and various techniques for predicting the occurrences of solar-particle events. (auth) (USGRDR)

51338 (N-70-28728) TYPE III SOLAR RADIO BURST STORMS OBSERVED AT LOW FREQUENCIES. PART 1. STORM MORPHOLOGY. Fainberg, Joseph; Stone, R. G. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). May 1970. 24p. (NASA-TM-X-63934; X-615-70-186). NTIS.

Storms of Type 3 solar radio bursts observed from 5.4 to 0.2 MHz indicate the quasi-continuous production of Type 3 events observable for a half solar rotation but persisting in some cases for well over a complete rotation. The characteristics of these storms, including the dependence of occurrence and apparent drift rates on the disc position of the associated active region, are discussed. The drift rate dependence is shown to be a consequence of the propagation time of emission from the source to the observer. The occurrence rate of a burst every 10 seconds observed near CMP implies that, if this level of activity persists, then about a quarter of a million exciter packets are released into the interplanetary plasma during a complete rotation. Storm bursts are less intense than most isolated Type 3 bursts and occur over a more limited frequency range. There appears to be a very close relation between these storms and decametric continuum. (auth) (STAR)

51339 (N-70-28989) ACCELERATION AND MOTION OF IONS IN CORONA AND SOLAR WIND. Geiss, Johannes; Hirt, Peter; Leutwyler, Heinrich (National Aeronautics and Space Administration, Houston, Tex. Manned Spacecraft Center). Jun 1969. 49p. (NASA-TM-X-62952). NTIS.

Assuming a stationary, radial, spherically symmetric solar wind and a radial magnetic field direction in the vicinity of the Sun, an equation of motion for ions heavier than protons in the solar wind is derived. The general properties of this equation are discussed and the results of numerical integrations are given. These results are based on the assumption of Maxwellian velocity distribution functions for electrons, protons, and ions, but the effects of first-order deviations from such distributions are also presented and discussed. It is shown that dynamical friction, i.e., momentum transfer from protons to heavier ions accounts for the observed fact that heavier ions, if accelerated at all, normally reach the same velocity as the protons in the solar wind. Because of the nonlinear relation between dynamical friction and proton–ion velocity difference, a minimum proton flux is required to carry a certain ion species in the solar wind. Formulas comparing the minimum fluxes for different ions are given. The effects of ion motion and escape on abundances in the corona and in the outer convective zone of the Sun are discussed. (auth) (STAR)

51340 (N-70-29962) INTERPLANETARY ENERGETIC PARTICLE DIFFUSION COEFFICIENT DETERMINATION USING RANDOM WALK FROM SHOCK WAVES. Arens, John F. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Jun 1970. 31p. (NASA-TM-X-63942; X-646-70-226). NTIS.

A shock wave passing through the solar wind can apparently reflect energetic protons to build up an enhanced intensity in front of the shock wave. Values of the diffusion coefficient in interplanetary space and the reflection efficiency of the particles can respectively be calculated from the distance the enhanced region extends in front of the shock wave and the increase in intensity from the undisturbed intensity. Values are found by fitting the data of Ogilvie and Arens (1970) and describing properties of 1-MeV protons with pitch angle approximately 90° scattering through ~20°. (auth) (STAR)

51341 INTERPRETATION OF OPTICAL SOLAR POLARIZATION. Debarbat, Suzanne (Observatoire, Paris); Dumont, Simone; Pecker, Jean-Claude. Astrophys. Lett.; 6: 251-6(Oct 1970).

The interpretation of broad band measurements of polarization of the solar disk needs both calculations in the continuum (Thomson and Rayleigh polarization) and in the lines (resonance polarization). The observations are still not well represented by these calculations, especially with regard to their wavelength dependence: either a depolarization factor (due to elastic collisions) which is a function of wavelength, or an additional source of polarization, either solar or instrumental, must be introduced. (auth)

51342 NEW EXPERIMENTAL POSSIBILITY OF INVESTIGATING THE SOLAR CORONA: FREQUENCY MEASUREMENTS ON RADIO SOURCES WHEN OCCULATED BY THE SUN. Ferencz, Cs. (Committee on Space Research, Budapest); Tarcsai, Gy. Planet. Space Sci.; 18: 1213-23(Aug 1970).

In the years 1967 and 1968 researchers at the Naval Research Laboratory reported on an anomalous frequency decrease of the 21 cm radiation of Taurus A when the radio source passed near the Sun. Up to the present time no satisfactory explanation has been given of the effect. Based on a recently developed general theory of electromagnetic wave propagation, it is shown that the frequency decrease can be attributed to (e.g., electron) particle streams propagating with great velocities in the corona. Further occultational observations would yield an effective method of investigating the solar atmosphere. (auth) (UK)

51343 MAGNETIC-QUADRUPOLE RADIATION AND SOLAR CORONAL DE-EXCITATION. Garstang, R. H. (Univ. of Colorado, Boulder). Publ. Astron. Soc. Pac.; 81: 488-95(Oct 1969).

Transition probabilities were computed for a number of spectral lines due to magnetic–quadrupole radiation. Three such lines, in Fe IX, Fe XVII, and Fe XXV, appear to be of importance in the de-excitation of excited atoms in the solar corona. (auth)

51344 SIGNIFICANCE OF ENERGETIC ELECTRONS IN GENERATION OF s-COMPONENT OF SOLAR RADIO EMISSION. Zlotnik, E. Ya. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 678-83(1970). (In Russian).

It is shown that the main characteristics of typical s-component sources in the regions above spots cannot be explained by synchrotron (at the higher harmonics of the gyrofrequency) radiation of relativistic electrons and gyrofrequency (at the intermediate harmonics) radiation of "over-thermal" electrons in the active regions. It is noted that the idea of generation of radiation from local sources on the bases of bremsstrahlung and gyrofrequency (at the lower harmonics of the gyrofrequency) mechanisms does not contradict the experimental data. (auth)

51345 SOLAR WIND. Cowling, T. G. Observatory; 89: 217-24(Dec 1969).

A short history on the experiments and the deductions which led to the discovery of the solar wind is given. Properties of the solar wind determined since the discovery are discussed. (W.D.M.)

51346 UPPER LIMIT OF SOLAR NEUTRON FLUX ASSOCIATED WITH SOLAR FLARE ON SEPTEMBER 28, 1968. Kondo, Ichiro; Nagase, Fumiaki; Yasue, Hiroshi (Nagoya Univ., Japan). Rep. Ionosphere Space Res. Jap.; 24: 147-61(Jun 1970).

A neutron detector was carried up to 13 g/cm^2 atmospheric depth on September 28, 1968, from Haranomachi City, Fukushima Prefecture to observe neutron bursts associated with solar flares. The detector consisted of an organic liquid scintillator for the neutron detector, employing pulse-shape discrimination, and a pair of thin plastic scintillators surrounding entirely the liquid scintillator for rejection of charged particles. The detectable energy range for neutrons was between about 6 and 100 MeV. While the balloon was at ceiling altitude, there occurred a solar flare of importance 2B at 0150 U.T. accompanying decimeter-band solar radio bursts. The counting rate of the neutron detector did not show any significant increase associated with the solar flare. The upper limit for the total flux of neutrons at the Earth produced in the solar flare was determined to be 40 neutron cm^{-2} in the energy interval between 6 and 100 MeV. (auth)

51347 SOLAR OBSERVATIONS MADE AT CATANIA ASTROPHYSICAL OBSERVATORY DURING 1968. Osservatorio Astrofisico di Catania, Pubblicazioni Nuova Serie No. 141. Rome; Consiglio Nazionale delle Ricerche (1970). 173p.

During 1968 observations were regularly made on the following: photosphere; Hα chromosphere on the disk; Hα chromosphere at the limb; K chromosphere on the disk, K chromosphere at the limb; radio corona; and special events. Extensive tables of data are included. (W.D.M.)

51348 ORIGIN OF THE SOLAR SYSTEM. Nakano, Takenori (National Radio Astronomy Observatory, Green Bank, W. Va.). Progr. Theor. Phys. (Kyoto); 44: 77-98(Jul 1970).

By the contraction of an interstellar cloud with finite angular momentum the Sun and the disk-shaped nebula around it were formed. The nebula was initially in a turbulent state. It is shown qualitatively that, as the turbulence dissipates, the nebula is gradually divided into rings and that the orbital radii of the rings satisfy Bode's law. (W.D.M.)

51349 POSITION MEASUREMENTS OF A HARMONIC TYPE-II SOLAR BURST. Riddle, A. C. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Proc. Astron. Soc. Aust.; 1: 310-12(Apr 1970).

The standard electron density model is used to explain the observed position and movements of the Type-II burst of March 2, 1969, observed at 80 MHz. Both this and the subsequent Type-II emission are consistent with a disturbance moving through the corona along the streamer axis with an essentially constant velocity only slightly less than that observed at the photosphere. (Australia)

51350 NON-LTE ANALYSIS OF SPECTRAL LINES. Mugglestone, D. (Queensland Univ., Brisbane). Proc. Astron. Soc. Aust.; 1: 296-301(Apr 1970).

The basic theory of non-LTE analysis is developed with particular reference to the solar atmosphere. All physical parameters are specified as functions of optical depth. The collisional and radiative processes involved are described, and the situations of a two-level atom without continuum and a three level atom with continuum are considered. Examples of solar sodium D-line profiles are given. (Australia)

51351 RADIO OBSERVATIONS OF THE STRUCTURE OF THE SOLAR CORONA. Sheridan, K. V. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Proc. Astron. Soc. Aust.; 1: 304-5(Apr 1970).

Two-dimensional pictures showing detailed features of the quiet Sun and weak, but moderately stable structure at meter wave lengths, are presented. Observations were made at 80 MHz with the Culgoora radioheliograph. Generally, the pictures show a distribution with limb darkening as anticipated, and nearly circular shape. Weak sources are noted that participate in general solar rotation and bulge outwards of the limb contours in places. These sources have a moderately stable existence. (Australia)

51352 RADIO EVIDENCE FOR THE PROPAGATION OF MAGNETOHYDRODYNAMIC WAVES ALONG CURVED PATHS IN THE SOLAR CORONA. Smerd, S. F. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Proc. Astron. Soc. Aust.; 1: 305-8(Apr 1970).

Heliograph observations at 80 MHz are described of a solar outburst on March 30, 1969, initiated by a flare on the invisible hemisphere of the Sun. Several questions of theoretical interest are raised, in particular, the implication that the magnetohydrodynamic waves responsible for certain Type II bursts must travel along curved paths. (auth) (Australia)

51353 EVIDENCE OF TYPE-II AND MOVING TYPE-IV SOLAR BURSTS EXCITED BY A COMMON SHOCK WAVE. Stewart, R. T.; Sheridan, K. V.; Kai, K. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Proc. Astron. Soc. Aust.; 1: 313-15(Apr 1970).

Three events recorded by the Culgoora radioheliograph, are summarized. In each event a Type-II and moving Type-IV burst could be consistently attributed to the effects of a common shock wave. Interpretation of the events led to the deduction that, at any one time, a wave could radiate Type-II emission at the fundamental and harmonic of the plasma frequency and, simultaneously, Type-IV emission at higher frequencies. This correlated with views that two types of emission originate in plasma waves and synchrotron radiation, respectively. (Australia)

51354 SCATTER IN THE POSITIONS OF SOURCES OF ASSOCIATED TYPE-III SOLAR BURSTS. McLean, D. J. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Proc. Astron. Soc. Aust.; 1: 315-16 (Apr 1970).

Observations made at 80 MHz with the Culgoora radioheliograph, showed that, although the sources of the Type-III bursts in a group tended to overlap, their centroids showed marked scatter, and their distribution tended to be along narrow lines across the solar disc. These discs were thought to represent some structural feature of the outer corona. (Australia)

51355 SOLAR U-BURST AT METRE WAVELENGTHS. Labrum, N. R.; Stewart, R. T. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Proc. Astron. Soc. Aust.; 1: 316-18(Apr 1970).

Observations are presented of U bursts, comprising dynamic spectra at 10 to 200 MHz. Results indicated that the properties of U-bursts are consistent with a model based on the guiding of fast-electron streams along loops in the coronal magnetic field. (Australia)

51356 POSITIONS OF THE FUNDAMENTAL AND HARMONIC SOURCES OF A TYPE-II SOLAR BURST. Dulk, G. A. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Proc. Astron. Soc. Aust.; 1: 308-10(Apr 1970).

The positions and motions observed in the Type II burst of October 9, 1969, are qualitatively explained with a model in which a directed shock wave intersects a coronal streamer and generates forward fundamental radiation and backward harmonic radiation. The split bands that come from different locations, may arise from different parts of the shock front as they encounter favorable geometrical conditions, opposed to the electron density contours. (Australia)

Galaxies

Refer also to abstracts 50347 and 51312.

51357 SPECTRAL VARIATION IN THE SEYFERT GALAXY NGC 1566. Pastoriza, M. (Observatorio Astronomico e IMAF,

Cordoba, Argentine); Gerola, H. Astrophys. Lett.; 6: 155-6 (Sep 1970).

Spectroscopic observations carried out in 1963 and 1969 seem to indicate variations in the spectrum of the nucleus of NGC 1566, in particular a weakening of Hβ with respect to N_1 and N_2 lines of [O III]. (auth)

51358 TIME-DEPENDENT MODEL OF THE INTERSTELLAR MEDIUM. Bottcher, C. (Harvard Coll. Observatory, Cambridge, Mass.); McCray, R. A.; Jura, M.; Dalgarno, A. Astrophys. Lett.; 6: 237-41(Oct 1970).

Ultraviolet ionizations from supernovae and hot stars may contribute significantly to the ionization and heating of the interstellar medium. Numerical solutions of the time-dependent recombination and cooling equations suggest a possible mechanism of the formation of interstellar clouds. Observational characteristics of a time-dependent model are similar in important respects to those of the steady-state model. (auth)

51359 SEARCH FOR HIGH-VELOCITY HYDROGEN CLOUDS AT NEGATIVE VELOCITIES AND NEGATIVE LATITUDES. McCutcheon, W. H. (Univ. of British Columbia, Vancouver). Astrophys. Lett.; 6: 221-4(Oct 1970).

Observations were extended to −380 km/sec in a search for high-velocity hydrogen clouds at negative latitudes. No new clouds were found. The upper limit on any signal is $T_b \leq 0.5$ K. (auth)

51360 INTERESTING NEUTRAL HYDROGEN FEATURE IN THE DIRECTION OF THE NORTH POLAR SPUR. Verschuur, G. L. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astrophys. Lett.; 6: 215-20(Oct 1970).

An unconventional way of displaying 21-cm line data has revealed several interesting features in a region around $l^{II} = 42°$, $b^{II} = 50°$. A particularly striking "cloud," possibly associated with the magnetic field lines in the North Polar Spur, is discussed. It is stressed that such features could never have been detected in the conventional maps and that the models of interstellar H I "clouds" may be heavily dependent on the way the data are presented and examined. (auth)

51361 GALACTIC HYDROGEN ABSORPTION AT 21-cm WAVELENGTH IN THE DIRECTION OF VIRGO A. Colvin, R. S. (Stanford Univ., Calif.); Hughes, M. P.; Thompson, A. R.; Verschuur, G. L. Astrophys. Lett.; 6: 211-14(Oct 1970).

The optical depth at λ21 cm in the direction of Virgo A is 0.017 ± 0.003 near the velocity of the peak of the galactic background emission, and the corresponding gas temperature lies within the range 180 to 460 K. In the negative-velocity wing of the emission profile the optical depth is less than 0.002 which indicates a minimum gas temperature of 600 K. (auth)

51362 EVIDENCE FOR A GAP BETWEEN THE CARINA AND SAGITTARIUS ARMS IN THE GALAXY. Kerr, F. J.; Kerr, Maureen (Univ. of Maryland, College Park). Astrophys. Lett.; 6: 175-7(Sep 1970).

Histograms of the longitude distribution of the flux in the 11-cm continuum and in recombination-line sources provide evidence that the Carina and Sagittarius arms are separate features of the galactic spiral structure. This method is independent of kinematic distances. (auth)

51363 STRUCTURE OF NORMAL GALAXIES AT 2695 MHz. Kazes, I.; Le Squeren, A. M.; Nguyen-Quang-Rieu (Observatoire, Meudon, France). Astrophys. Lett.; 6: 193-6(Oct 1970).

Normal galaxies detected previously at 1415 MHz were observed at 2695 MHz, with an antenna of beam width 2.3 × 11 arc min., mainly in order to study their structure. The distribution of their radio diameters confirmed the existence of two classes of galaxies. The emission of the first class is concentrated in the nuclear region while that of the second class is extended over the whole disk. However, the characteristics of both classes could co-exist in the same galaxy. Some considerations on the structure and the evolution are given. (auth)

51364 STRUCTURE OF THE VIRGO CLUSTER AS DETERMINED FROM SUPERNOVAE. Kowal, Charles T. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Publ. Astron. Soc. Pac.; 81: 608-12(Oct 1969).

The apparent magnitudes of supernovae were used to determine the relative distances of members of the Virgo cluster of galaxies. It was found that the distances so derived differ markedly from the distances required by a multiple-group interpretation of the structure of the cluster. It is suggested that the cluster is essentially a single dynamical unit, and that the differences in galaxy velocities and luminosities, which were observed by de Vaucouleurs, must be explained by means other than differences in the distances of the galaxies. (auth)

51365 ON THE STABILITY OF THE LOCAL GROUP. Herbst, William Jr. (Princeton Univ. Observatory, N. J.). Publ. Astron. Soc. Pac.; 81: 619-28(Oct 1969).

The dynamics of the Local Group was investigated using the virial theorem in detail, with various assumptions about the orbits and the binding of subgroups. It was concluded that the Local Group is stable against disruption without the assumption of "missing mass." (auth)

51366 PECULIAR GALAXY NGC 6052. Du Puy, D. L. (Kitt Peak National Observatory, Tucson, Ariz.); De Veny, J. B. Publ. Astron. Soc. Pac.; 81: 637-42(Oct 1969).

Observational results are presented for the galaxy NGC 6052. Spectrograms at 130 Å/mm were measured for radial velocities at six points on the galaxy. The results suggest that the differences in velocity ($\Delta V \simeq 135$ km/sec) are not due entirely to rotation; an outflow of material may be partially responsible. (auth)

51367 COMPACT GALAXY Zw I 0120 + 34. Fairall, A. P.; Angione, R. J. (Univ. of Texas, Austin). Publ. Astron. Soc. Pac.; 81: 685-7(Oct 1969).

A question has arisen concerning possible optical variation in the compact galaxy Zw I 0120 + 34. Since this phenomenon is known for other members of this class, and since Zw I 0120 + 34 is an unusually interesting object by virtue of its size and structure, it was investigated more closely. Some of its characteristics are reported and failure to find conspicuous variation is noted. (W.D.M.)

51368 TIDAL EFFECTS IN THE COMA CLUSTER OF GALAXIES. Noonan, Thomas W. (Brockport State Coll., N. Y.). Publ. Astron. Soc. Pac.; 82: 821-4(Aug 1970).

A consideration of tidal effects in the Coma cluster of galaxies due to the gravitational field of the cluster as a whole indicates that tidal forces, if they are important, should affect the larger galaxies more than the smaller ones. This effect is suggested as a method for investigation of the distribution of cluster mass. (auth)

51369 HYDROXYL GAS CLOUDS NEAR THE GALACTIC CENTER. McGee, R. X. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Aust. J. Phys.; 23: 541-58(Aug 1970).

Following on observations of the 1667-MHz absorption lines in directions near the galactic center (Robinson and McGee 1970) the effect of the continuum background was eliminated by the introduction of the apparent opacity $\tau_a = (T_{line}/T_{continuum})$. Contours of τ_a on galactic longitude–radial velocity coordinates for a number of galactic latitudes enabled clouds of hydroxyl gas to be recognized and listed. Properties such as characteristic radial velocity, velocity dispersion, size, and maximum value of apparent opacity are given and discussed for 63 clouds. (auth) (Australia)

51370 GALAXY IDENTIFICATIONS FROM THE PARKES 2700-MHz SURVEY: THE SELECTED REGIONS AND THE $+4^{0}$ DECLINATION ZONE. Merkelijn, J. K. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia); Wall, J. V. Aust. J. Phys.; 23: 575-94(Aug 1970).

Identifications with galaxies are given for 127 of the radio sources in the first two parts of the Parkes 2700-MHz survey. (auth) (Australia)

51371 NORMAL ELLIPTICAL GALAXIES. Freeman, K. C. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 1: 302-3(Apr 1970).

The dynamical and physical properties of normal E galaxies are discussed. These include the structure, mass–luminosity ratio, angular momentum, stellar content, and interstellar matter. (Australia)

Cosmology

Refer also to abstract 52037.

51372 (AD-709149) LEMAITRE MODELS AND THE COSMOLOGICAL CONSTANT. Petrosian, Vahe; Salpeter, E. E. (Stanford Univ., Calif. Inst. for Plasma Research. Cornell Univ., Ithaca, N. Y. Dept. of Physics). Jun 1970. Contract N00014-67-A-0112-0006. 17p. (SU-IPR-371). NTIS.

The discovery of quasi-stellar objects with large redshifts has renewed interest in the cosmological constant and in the Lemaitre-type cosmological models. Recent views are reviewed in this document. (USGRDR)

51373 (N-70-26123) EXPLODING STARS AND GALAXIES. Gorbatskii, V. G. Translation of Kosmicheskie Vzryvyii, Nauka, Moscow, 1967. 125p. (NASA-TT-F-559; TT-69-55022). NTIS.

The physics of cosmic explosions is discussed in terms com-

prehensible to the average layman with a high school education. The subject matter covers methods of studying cosmic explosions, the state of matter in the Universe, the energy of cosmic bodies, explosions on the Sun and their effect on the Earth, exploding stars, supernovae, explosions in galactic nuclei, quasars, and the role of explosions in the evolution of star nuclei, quasars, and the role of explosions in the evolution of stars and galaxies. Various numerical estimates are made to ensure a more complete understanding of the effects involved. (STAR)

51374 ORIGIN OF COSMIC MAGNETIC FIELDS. Brecher, Kenneth; Blumenthal, George R. (Univ. of California, San Diego, La Jolla). Astrophys. Lett.; 6: 169-73(Sep 1970).

The possible sources of primeval magnetic fields were examined and found to be inadequate to account for the observed galactic B fields (if the magnetic fields in galaxies are the result of the condensation of a magnetized metagalactic medium). Limits were placed on the value of any present intergalactic magnetic field of either primordial or "recent" origin. (auth)

51375 UPPER LIMIT TO THE MASS FORMED IN A RADIATION-DOMINATED UNIVERSE. Shaviv, G.; Kovetz, A. (Tel Aviv Univ., Ramat Aviv, Israel). Astrophys. Lett.; 6: 129-30 (Sep 1970).

In a universe with specified molecular weight and entropy per unit mass there is an upper limit to the mass of a self-gravitating, spherical configuration. The limit is of the order of the Jeans mass. (auth)

51376 ELEMENTARY PARTICLES IN COSMOLOGY. Omnes, R. (Faculte des Sciences, Orsay, France). Ann. Phys. (Paris); 4: 515-42(Sep-Oct 1969). (In French).

Some recent progress in understanding the physical properties of the simplest model of the Universe, namely, an isotropic and homogeneous model that contains initially only thermal radiation, is considered. Taking into account the properties of nucleon–antinucleon interactions, one justifies the possible existence of a phase transition in thermal radiation above a temperature of 350 MeV. This transition produces a spatial separation between the nucleons and antinucleons, which constitutes by then, an emulsion. A study of the emulsion behavior leads to a prediction of the most conspicuous characteristics of the Universe: matter density, the universal black-body radiation, galaxy formation, and mass and radius of galaxies. All these phenomena are obtained quantitatively. The model also predicts the existence of some objects of galactic type, made of matter surrounding a core of antimatter (or the reverse). Such systems explain, quantitatively, the properties of quasars and the gamma radiation observed at energies above 100 MeV. They lead to a simple explanation for the existence of galactic nuclei. (auth)

51377 APPROXIMATE SOLUTION OF GRAVITATIONAL EQUATIONS OF EXPANDING UNIVERSE. Sengupta, P. (City Coll., Calcutta). Phys. Lett.; 32A: 463-4(7 Sep 1970).

Einstein's gravitational equations of the expanding Universe are solved by neglecting cosmological terms. The possibility of sudden collapse of the expanding Universe into zero volume with infinite density at that stage is shown. (auth)

51378 QUASI-MAXWELLIAN EQUATIONS OF INERTIAL–GRAVITATIONAL FIELDS. Raigorodski, L. D. (Shipbuilding Inst., Leningrad). Phys. Lett.; 32A: 527-8(7 Sep 1970).

Some questions connected with the form of the equations of inertial–gravitational fields and their sources are discussed. (auth)

51379 NONLINEAR EFFECT OF COSMIC FLUID IN AN EXPANDING UNIVERSE. Narlai, Hidekazu (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 44: 110-24(Jul 1970).

In order to clarify the process of galaxy formation, basic equations for dealing with various nonlinear effects of cosmic fluid, such as the interaction between eddy motions and shearing ones and the nonlinear character of gravity for the promotion of density contrast, are derived from Newtonian hydrodynamical equations in an expanding Universe, which are suitable after the decoupling of matter from the primordial radiation. The equations are localized by means of power series expansion of relevant quantities in the neighborhood of an equilibrium point in the fluid and solved in several cases. As a result, it is shown that, if a suitable rotation specified by a parameter e such as $1 \geq e \geq 0$ exists, the rotating body becomes a gravitationally bound system at an instant when the density ratio to the background reaches the value $(3\pi/4)^2(2/(1+e))^3$. Basic equations for dealing with Ozernoi and Chernin's mechanism for hydrodynamical instability before the decoupling time are also derived in a tentative manner. (auth)

51380 DUST-FILLED UNIVERSES OF CLASS II AND CLASS III. Ozsvath, Istvan (Univ. of Texas, Dallas). J. Math. Phys. (N. Y.); 11: 2871-83(Sep 1970).

On the Lie group $R \times H^3$ two different families of left-invariant metrics are constructed which satisfy the Einstein field equations with incoherent matter, calling the Riemannian spaces M_4, obtained this way, Class II and Class III universes. The geometry of these universes is discussed. (auth)

Planetary Phenomena

Refer also to abstract 50462.

51381 RATE CONSTANTS FOR THE REACTION OF CO_2^+ WITH O, O_2, AND NO; N_2^+ WITH O AND NO; AND O_2^+ WITH NO. Fehsenfeld, F. C.; Dunkin, D. B.; Ferguson, E. E. (ESSA Research Labs., Boulder, Colo.). Planet. Space Sci.; 18: 1267-9 (Aug 1970).

Because of its importance in the Martian ionosphere, the authors measured the reaction of CO_2^+ with atomic oxygen in a flowing afterglow system at 295°K. The reaction has a rate constant 2.6×10^{-10} cm³/sec and appears to produce both O_2^+ and O^+ as product ions, approximately in the ratio 5 : 3. The reactions of CO_2^+ with O_2 and NO were also measured in the course of these experiments as well as the reactions of N_2^+ with O and NO and O_2^+ with NO. (auth) (UK)

51382 RADIO FREQUENCY SPECTRUM OF JUPITER. Gleeson, L. J.; Legg, M. P. C.; Westfold, K. C. (Monash Univ., Clayton, Australia). Proc. Astron. Soc. Aust.; 1: 320-2(Apr 1970).

Extensions and variations of the dipolar model in the range 80 to 10,000 MHz are shown to account for the decrease in flux below 300 and above 3000 MHz. (Australia)

Atomic and Molecular Physics

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

Refer also to abstracts 51158, 51185, 51772, 51791, 51799, and 51867.

51383 (LA-4443) CALCULATION OF LIGHT-PARTICLE ENERGY LOSS IN THICK FOILS. Brown, W. K.; Watkins, D. W. (Los Alamos Scientific Lab., N. Mex.). May 1970. Contract W-7405-eng-36. 7p. Dep. CFSTI.

Results are presented of a computer calculation of the average energy loss of light particles in selected target foil materials which have high neutron cross sections. The listed FORTRAN program has sufficient flexibility to be of use in calculating the average total energy deposited in solid-state detectors from any light particle-producing-reaction and for any target material. The calculation serves as a useful check in the analysis of neutron flux measurements using underground nuclear explosions. (auth)

51384 X-RAY SPECTRA FROM OXYGEN-ION BOMBARDMENTS ON Ca AND V AT 15 MeV. Burch, D.; Richard, Patrick (Univ. of Texas, Austin). Phys. Rev. Lett.; 25: 983-6(12 Oct 1970).

K x-ray spectra of Ca and V as produced by 15-MeV O^{4+} ion bombardment are compared with 6-MeV proton-induced spectra. The $K\alpha$ and $K\beta$ lines from the O^{4+} bombardment are found to be shifted approximately 54 and 157 eV, respectively, relative to the proton-induced spectra. Hartree–Fock–Slater calculations show that the observed shifts are on the order of those expected from atoms with two or three additional inner-shell vacancies. It is suggested that it is unlikely that the known low-energy ion–atom interactions could be responsible for such inner-shell ionization configurations. (auth)

51385 ENERGY DISTRIBUTIONS IN SPUTTERING PROCESSES BY ION BOMBARDMENT. Oechsner, H. (Univ., Wuerzburg, Ger.). Z. Phys.; 238: 433-51(1970). (In German).

The energy distributions of the neutral particles sputtered from polycrystalline targets of Al, Ti, Ni, Cu, and Ag by normally incident Ar^+ ions in the 1-keV region were determined for ejection energies below 20 eV in a direction close to the normal target surface. The experimental method employed is strongly connected to the characteristic properties of a low-pressure electrodeless hf plasma used as an effective ion source as well as an ionizing medium for the ejected target atoms. The resulting curves always show a maximum at most probable ejection energies between 1 and 5 eV, being approximately half of the surface binding energy. These curves are converted to the corresponding energy distributions for the recoil atoms within the target by an energy-

dependent factor. It is found that the energy distribution within the bombarded solid decreases monotonically with the inverse square of the energy of the recoils. (auth)

51386 APPLICATION OF THE UNCERTAINTY PRINCIPLE TO STOPPING POWER THEORIES. Walsh, P. J. Health Phys.; 19: 574-6(Oct 1970).

The restrictions placed upon the classical theory and quantum mechanical theory of stopping power by the uncertainty principle are discussed with a view toward evaluating what similar restrictions might apply to a classical theory based upon the interaction of a penetrating charged particle with the average charge distribution of an atom of the stopping material. It is concluded that these restrictions should not be applied to classical mechanics or to quantum mechanics in general. The uncertainty principle is normally applied for a particular model and the form or severity of the restriction may be changed in many cases simply by changing the model. (auth) (UK)

51387 BACKSCATTERING OF LIGHT ATOMIC PROJECTILES FROM THIN Au FILMS IN THE ENERGY RANGE 50 TO 110 keV. Van Wijngaarden, A.; Brimner, E. J.; Baylis, W. E. (Univ. of Windsor, Ont.). Can. J. Phys.; 48: 1835-44(15 Aug 1970).

Thin gold films, vacuum-deposited onto a beryllium substrate, were irradiated by ions of ^{1}H, ^{4}He, ^{7}Li, and ^{11}B in the energy range 50 to 110 keV and the backscatter intensity was measured at a laboratory scattering angle of 136.4°. An analytic expression for the scattering cross section in a shell-shielded Coulomb potential was derived and is found to be in good agreement with the present experimental results. For thin films the observed backscatter yield is not proportional to the film thickness, but increases more rapidly. The enhancement in the yield can be explained by small-angle multiple deflections. It was corrected for, using estimates for the angular divergence of a beam passing through a thin stopping region. (auth) (Canada)

51388 $K\alpha_2/K\alpha_1$ TRANSITION PROBABILITIES IN ELEMENTS WITH $Z \leq 50$. Salem, S. I.; Wimmer, R. J. (California State Coll., Long Beach). Phys. Rev., A; 2: 1121-3(1 Oct 1970).

The $K\alpha_2/K\alpha_1$ transition probabilities were measured for 22 elements ranging in atomic number from 21 to 50, with an estimated error of about 2%. This was accomplished by bombarding the elements with an electron beam of constant energy and studying the x-ray emission spectrum. The measured ratios rise gently above the classical limit as the atomic number increases, in contrast to the dip below this limit previously reported for $30 \leq Z \leq 40$. For $Z \geq 30$, the experimental results are in excellent agreement with recent calculations based on the relativistic Hartree–Slater potential. For $Z \leq 30$, although experimental results agree with theoretical calculations to within experimental error, they tend to be lower. (auth)

51389 MOLECULAR COHERENCE EFFECTS IN RADIATION PROCESSES: BREMSSTRAHLUNG. Borie, Edith (Univ. of Trondheim, Norway. National Bureau of Standards, Washington, D. C.); Maximon, Leonard C.; Olsen, Haakon Phys. Rev., A; 2: 1443-9(1 Oct 1970).

The influence of molecular structure on the bremsstrahlung process at low energies was studied for diatomic molecules. Interference effects give rise to an increase in the total radiation cross section, which is large for low electron energies. Although the various cross sections are calculated in the Born approximation, the results are expected to be qualitatively correct. (auth)

51390 MEASUREMENT OF CROSS SECTIONS FOR X-RAY PRODUCTION BY HIGH-ENERGY ELECTRONS. Middleman, L. M.; Ford, R. L.; Hofstadter, R. (Stanford Univ., Calif.). Phys. Rev., A; 2: 1429-43(1 Oct 1970).

High-resolution semiconductor detectors were used to make a study of the large K-ionization cross sections of atoms over a wide range of atomic numbers ($Z = 29$ to 83) and of incident electron energies ($E = 150$ to 900 MeV). For the higher-Z elements ($Z > 60$), the L x-ray cross sections were also measured over the incident-electron energy range. Ratios of the relative intensities of various distinct lines were determined and compared to recent low-energy work. The results of the K-ionization experiment are compared to the recent relativistic calculations of Kolbenstvedt. The experimental K-ionization cross sections for each incident-electron energy appear to fit a power-law dependence on the atomic number. The Kolbenstvedt theory also exhibits a power-law dependence and is in good agreement with this experiment. All differential x-ray cross sections were found to be isotropic. The L x-ray cross sections measured for four high-Z elements increase with atomic number and incident electron energy. The $L\beta/L\alpha$, $L\gamma/L\alpha$, and K/L intensity ratios are also given. A search for nuclear γ rays produced by high-energy electron scattering was also undertaken in this work. No nuclear γ-ray lines were detected. Recent theoretical calculations show that the expected cross sections are below the minimum observable levels in these experiments. However, a 511-keV γ line was observed. This line was associated with positron annihilation and was apparently produced in the target. (auth)

51391 LOW-ENERGY Ar^+ SPUTTERING YIELDS OF SOLID AND LIQUID TIN. Krutenat, R. C.; Panzera, C. (Pratt and Whitney Aircraft, Middletown, Conn.). J. Appl. Phys.; 41: 4953-7(Nov 1970).

Low-energy Ar^+ sputtering yields were obtained for solid and liquid tin from threshold to 1200 eV. The solid yield at 200 eV is twice that for the liquid but a crossover occurs at 375 eV above which liquid yields are 15% higher. The liquid-yield curve exhibits a linear dependence up to $E = 475$ eV and breaks sharply to a lower dependence on ion energy. Yields of remelted solid were intermediate between the curves for liquid and solid, demonstrating the effect of surface roughness on the yield for polycrystalline targets. This work confirms experimentally the theory of Sigmund for yield of amorphous targets particularly in the low-energy range near threshold where surface effects predominate. (auth)

Atomic and Molecular Properties

Refer also to abstracts 51635 and 51650.

51392 (CONF-700403-5) CERIUM(III)-SENSITIZED TERBIUM(III) LUMINESCENCE IN THORIUM-ORTHOPHOSPHATE. Heindl, R.; Guerin, V.; Loriers, J. (Centre National de la Recherche Scientifique, Bellevue (France). Laboratorie des Terres Rares). [1969]. 12p. Dep. CFSTI (U. S. Sales Only).

From 8th Rare Earth Conference, Reno, Nev.

The luminescence of Tb(III)-activated Ce(III)-sensitized thorium orthophosphate under ultraviolet excitation was investigated. While Th(IV) ions are sometimes sensitizers for Ce(III) ions, in the present compound Ce(III) sensitizes the terbium emission. From the optical measurements, it is concluded that an energy transfer from Ce(III) to Tb(III) occurs. The fluorescence emission spectra are much alike to those found in the isomorphous $CePO_4$: Tb investigated recently by Denis and Loriers. (auth)

51393 (NP-18425) MECHANISMS OF POST-LUMINESCENCE OF NITROGEN IRRADIATED BY ALPHA PARTICLES. Millet, Pierre (Toulouse Univ. (France). Faculte des Sciences). 1970. 100p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis.

The mechanism of the luminescence of pure nitrogen at pressures between 50 and 700 torrs irradiated by alpha particles from ^{210}Po was studied. The main band heads found in the emission spectra of this gas occurred between wavelengths of 200 and 800 nm. The study of the law of variation, according to the pressure, of the ratio of the intensities at the band heads of the first negative system of N_2^+ and the second positive system of N_2 yields information about the loss of excitation energy process. (tr-auth) (France)

51394 CONFIGURATION $4f^6(^7F)5d6s^2$ IN Eu I. Smith, G. (Oxford Univ.); Wilson, M. J. Opt. Soc. Amer.; 60: 1527-8 (Nov 1970).

An approximate calculation of the level structure of configuration $4f^6fd6s^2$ was made, and results were compared with a diagram of observed levels. From this comparison it was concluded that level 106 must have a J value of ½. With this change 16 more of the observed levels were identified as belonging to this configuration. (A.G.W.)

51395 CALCULATION OF THE ATTRACTIVE He PAIR POTENTIAL. Schaefer III, Henry F.; McLaughlin, Donald R.; Harris, Frank E.; Alder, Berni J. (Univ. of California, Livermore). Phys. Rev. Lett.; 25: 988-90(12 Oct 1970).

The symmetry-adapted pair-correlation energy of diatomic helium was evaluated for five internuclear separations near the potential minimum by means of localized orbitals obtained from transformation of a molecular Hartree–Fock wave function. An attractive potential depth of 12.0°K at $R = 2.96$ Å was obtained in agreement with the best experimental estimates, leading to the conclusion that the omitted electron correlation within the helium atom does not affect the interatomic correlation energy by more than about 10%. This result is in essential agreement with that obtained independently by Bertoncini and Wahl. The electron correlation contribution is divided into σ, π, and δ parts as well as into its atomic symmetry so as to elucidate the magnitude of the various contributions. (auth)

51396 AB INITIO CALCULATION OF THE HELIUM–HELIUM $^1\Sigma_g^+$ POTENTIAL AT INTERMEDIATE AND LARGE SEPARATIONS. Bertoncini, P.; Wahl, Arnold C. (Argonne National Lab., Ill.). Phys. Rev. Lett.; 25: 991-4(12 Oct 1970).

A five-configuration wave function computed by multiconfiguration self-consistent-field techniques yielded a well depth ϵ/k = 10.48°K at r_m = 5.659 bohrs and a potential zero σ = 5.037 for the interaction of ground-state He atoms. Improvement of the basis set yields, at R = 5.60, a potential U(R) = 11.38°K. It is suggested that calculations in the vein of the present approximation should converge to a well depth of close to 12°K. The long-range behavior of our potential is unexpectedly close to that commonly accepted for He–He and may change by as much as 15% as the wave function, in its present approximation, is improved. (auth)

51397 CALCULATION OF THE SLOPE AT $q^2 = 0$ OF THE DIRAC FORM FACTOR FOR THE ELECTRON VERTEX IN FOURTH ORDER. Soto, M. F. Jr. (City Univ., New York). Phys. Rev., A; 2: 734-58(Sep 1970).

The slope at $q^2 = 0$ of the Dirac form factor for the electron vertex in fourth order is calculated. The result is $\kappa^2 \partial F_1^{(4)}/\partial q^2|_{q^2=0} = (\alpha/\pi)^2(0.107\ 648)$. This result affects the energy levels of hydrogenic atoms and can be represented as an addition to the interaction energy density of the electron with the external field in the form $-ie[\bar{\Psi}(x),\gamma_\mu\Psi(x)]\{(\Box^2/\kappa^2)A_\mu^e(x) \times [(\alpha^2/4\pi^2)(0.215\ 296)]\}$, where κ is the mass of the electron. This term contributes to the level shift in a hydrogenic atom an energy of $\delta_{1s}[4(z\alpha)^4\kappa c^2/n^3](\alpha/\pi)^2$ (0.107 648). This calculation reduces the uncertainty in the theoretical result by about 50% to ±0.1 MHz, which is about the size of the experimental error. (auth)

51398 SECOND-ORDER CALCULATION OF THE HYPERFINE SPLITTINGS IN ATOMIC HYDROGEN. Gregson, M. J. (Leicester Polytechnic, Eng.); Hall, G. G.; Rees, D. J. Phys., B (London); 3: 1195-1200(Sep 1970).

The energy contributions given by second-order perturbation theory for the hyperfine interaction become finite when the delta function is replaced by an exponential. The exponential is also a better approximation than a delta function to the hyperfine potential derived from the Dirac theory. The results are applied to the 1s and 2s states of the hydrogen atom. The effect of the second-order terms is small. Errors in an earlier calculation are discussed. (auth) (UK)

51399 RESONANCE BROADENING OF THE L_α LINE OF HYDROGEN. Skidan, V. V.; Shreider, E. Ya. Opt. Spectrosc. (USSR) (Engl. Transl.); 28: 340-1(Apr 1970).

Translated from Opt. Spektrosk.; 28: 627-9(Apr 1970).

The width of the dispersion contour of the L_α resonance line of hydrogen was investigated using the method of optical absorption. (auth)

51400 DEPENDENCE OF THE QUADRUPOLE MOMENT OF THE HYDROGEN MOLECULE ON INTERNUCLEAR DISTANCE. Adamov, M. N.; Bulychev, V. P. Opt. Spectrosc. (USSR) (Engl. Transl.); 28: 453(Apr 1970).

Translated from Opt. Spektrosk.; 28: 835-6(Apr 1970).

Results of calculation of the quadrupole moment of the hydrogen molecule at internuclear distances from 0.2 to 8.0 a.u. are tabulated. (A.G.W.)

51401 ONE-PHOTON TRANSITION FROM THE METASTABLE LEVEL OF THE HYDROGEN ATOM CONSIDERING SPIN STATES. Zhukovskii, V. Ch.; Kolesnikova, M. M.; Sokolov, A. A.; Kherrmann, I. Opt. Spectrosc. (USSR) (Engl. Transl.); 28: 337-9(Apr 1970).

Translated from Opt. Spektrosk.; 28: 622-6(Apr 1970).

The probability of a spontaneous transition from the $2s_{\frac{1}{2}}$ metastable level of the hydrogen atom was determined, allowing for the spin states. At the same time, the Breit–Teller formula describing an analogous process was corrected. In conclusion, the probability of an induced transition from the same level is calculated. (auth)

51402 DIPOLE POLARIZABILITY OF THE HYDROGEN MOLECULE: A SINGLE-CENTER CALCULATION. Cohen, M.; Southern, B. W. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 48: 1991-5(1 Sep 1970).

The leading terms in a single-center expansion of the static dipole polarizability tensor of the hydrogen molecule were calculated by means of perturbation theory. (auth)

51403 RELATIVE ORBITAL AND MAGNETIC SUBSTATE AMPLITUDES IN SINGLE-FOIL EXCITATION OF FAST HYDROGEN ATOMS. Sellin, I. A.; Biggerstaff, J. A.; Griffin, P. M. (Oak Ridge National Lab., Tenn.). Phys. Rev., A; 2: 423-9(Aug 1970).

Within the limits set by our experimental apparatus, large-amplitude zero-field oscillations of H fine-structure amplitudes treated in a recent letter of Macek were not observed in polarization-versus-flight-path measurements on H_β, H_γ, and Ly_α emissions from suddenly excited H atoms (50- and 150-keV incident protons). Random initial phases for orbital and magnetic substates and approximately equal magnetic substate populations are indicated, in contrast to binary electron capture in gases. A successful test of the theoretical polarization of 2s Stark quench radiation was also made. (auth)

51404 BROADENING OF THE He II LINE λ = 4686 Å IN A PLASMA. Bogen, P. (European Space Research Inst., Frascati, Italy). Z. Naturforsch.; 25a: 1151-3(Jul 1970).

The profile of the He^+ λ = 4686 Å line was measured in a plasma with an electron density of 5.5×10^{17} cm^{-3} and a temperature of 6×10^4 °K. The measured halfwidth is consistent with that predicted by the Griem and Shen theory. On the far wings the intensity approaches the value expected when ions and electrons are treated by the static theory, although the electrons are far outside the static broadening regime. (auth)

51405 INFLUENCE OF A STRONG MAGNETIC FIELD ON PLASMA-BROADENED 2P–4Q (Q = P,D,F) He I LINES. Deutsch, C. (Faculte des Sciences, Paris). Phys. Rev., A; 2: 1258-61 (1 Oct 1970).

The profiles of He I 4471- and 4921-Å lines and their forbidden components were calculated for $N_e = 6 \times 10^{15}$ ecm^{-3} and $T_e = 2 \times 10^4$ °K in the presence of a 70-kG magnetic field, with the aid of an extended formulation of the impact theory. In both cases, the lines exhibit important modifications, which are not shown by isolated or completely degenerate lines in similar situations. (auth)

51406 HARTREE–FOCK DIAMAGNETIC SUSCEPTIBILITIES. Mendelsohn, Lawrence B. (Sandia Labs., Albuquerque, N. Mex.); Biggs, Frank; Mann, Joseph B. Phys. Rev., A; 2: 1130-4 (1 Oct 1970).

The diamagnetic susceptibilities of all free atoms up to Z = 103 are calculated within the nonrelativistic and relativistic numerical Hartree–Fock approximations. Relativistic calculations are also performed for certain ions. The use of Dirac self-consistent wave functions leads to lower calculated susceptibilities. This effect becomes appreciable at very large atomic numbers; e.g., in uranium a decrease of 12.3% below the nonrelativistic value is found. For the case of the rare gases, the Hartree–Fock diamagnetic susceptibilities are found to lie above the experimental values. This is attributed to the omitted effects of electron correlation. For the noble and divalent metals, the calculated atomic-core diamagnetic susceptibilities lie above the experimental metallic values, since we have not included the paramagnetism of the conduction electrons. (auth)

51407 ISOTOPE SHIFT IN 5525-A LINE OF NEODYMIUM. Saksena, G. D.; Ahmad, S. A.; Meenakshi, K. (Bhabha Atomic Research Centre, Bombay). Indian J. Pure Appl. Phys.; 7: 743-5(Nov 1969).

The isotopic structure of the 5525.7-Å Nd I line was recorded on a pressure-scanning-type Fabry–Perot spectrometer using samples of neodymium enriched in different isotopes. It was found that the above line is not a single line but consists of two very close lines λ_1 and λ_2. For isotope ^{142}Nd, the line λ_2 lies 45 mK (1 Kayser = 1 cm^{-1}) to the longer wavelength side of λ_1. Both the lines λ_1 and λ_2 show negative isotope shifts. The isotope shifts measured in line λ_1 are: $\Delta\sigma(^{142}\text{Nd}-^{144}\text{Nd}) = 77 \pm 1$ mK; $\Delta\sigma(^{142}\text{Nd}-^{143}\text{Nd}) = 40 \pm 3$ mK; $\Delta\sigma(^{142}\text{Nd}-^{146}\text{Nd}) = 74 \pm 1$ mK; and $\Delta\sigma(^{144}\text{Nd}-^{145}\text{Nd}) = 35 \pm 2$ mK. (auth)

51408 GEOMETRIC APPROXIMATION OF PHYSICAL PROPERTIES. Tuan, D. F.-T. (Kent State Univ., Ohio. Harvard Univ., Cambridge, Mass.). Chem. Phys. Lett.; 7: 115-20(1 Oct 1970).

Electric dipole polarizabilities of the Ne isoelectronic sequence, the Be atom, the H_2 molecule, a pair of interacting He atoms, and the magnetic susceptibility of the H_2 molecule are calculated by a geometric approximation. The numerical results are comparable to those obtained from the coupled Hartree–Fock method. It is also proved that the geometric approximation provides an approximation to the coupled Hartree–Fock second-order energy. Other remarks on the geometric approximation are also given. (auth)

Positronium, Muonium, and Mesic Atoms and Molecules

Refer also to abstracts 50362, 51816, 52105, 52149, 52500, 52599, 52600, 52604, and 52693.

51409 (CONF-690916–(Vol.1), pp 172-7) POSITRON ANNIHILATION: A NEW TOOL. Kulkarni, V. G. (Tata Inst. of Fundamental Research, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23–26, 1969. Vol. I.

The use of positron annihilation for structural studies is very briefly reviewed, and an experimental setup using ^{22}Na is briefly described. Typical graphical data for liquids, polymers and crystals is displayed. (L.M.T.)

51410 NON-RADIATIVE MUON TRANSITIONS IN HEAVY ELEMENTS. Kessler, D.; Chan, V.; Hargrove, C. K.; Hincks, E. P.; Mason, G. R.; McKee, R. J.; Ricci, S. (National Research Council, Ottawa. Carleton Univ., Ottawa). pp 144–9 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A new process in heavy muonic atoms consisting of the radiationless deexcitation of a muonic atom accompanied by an excitation of the nucleus is discussed. Some preliminary data on neutrons emitted in the radiationless excitation processes following muon absorption in gold, bismuth, and separated lead isotopes are described. (J.W.R.)

51411 VACUUM POLARIZATION IN MUONIC ATOMS. Anderson, Herbert L. (Univ. of Chicago). pp 640–6 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Studies of vacuum polarization effects in muonic atoms are reviewed, and it is pointed out that the precision in measuring muonic x-ray lines is now becoming high enough to provide a significant test of the vacuum polarization effects in muon physics not only in the lowest but also in higher orders. The situation for ^{208}Pb is used as an example; the various corrections that contribute to the observed energies of three of the more prominent transitions are tabulated. Another table shows electron screening and vacuum polarization corrections for the major higher transitions in muonic Pb. 13 references. (A.G.W.)

51412 MEASUREMENTS OF THE VACUUM POLARIZATION IN MUONIC ATOMS. Backenstoss, G. (CERN, Geneva); Charalambus, S.; Daniel, H.; Koch, H.; Malsburg, Ch. v. d.; Poelz, G.; Schmitt, H.; Tauscher, L. pp 675–6 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Measurements of vacuum polarization in the 5g–4f and 4f–3d transitions of Bi and natural Pb are reported briefly. The results agree well with theoretical values if higher-order corrections are included. (A.G.W.)

51413 RECENT MUONIUM HYPERFINE STRUCTURE MEASUREMENTS. Crane, P.; Amato, J. J.; Hughes, V. W.; Lazarus, D. M.; zu Putlitz, G.; Thompson, P. A. (Yale Univ., New Haven). pp 677–9 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Measurements of the hfs interval $\Delta\nu$ of muonium were made using Kr as the stopping gas in the pressure range from 6 to 73 atm and Ar in the range from 30 to 108 atm. An average value of $\Delta\nu$ of 4463.249 ± 0.031 MHz was obtained. (A.G.W.)

51414 PRECISION REDETERMINATION OF THE FINE-STRUCTURE INTERVAL OF THE GROUND STATE OF POSITRONIUM AND A DIRECT MEASUREMENT OF THE DECAY RATE OF PARAPOSITRONIUM. Theriot, E. D. Jr.; Beers, R. H.; Hughes, V. W.; Ziock, K. O. H. (Yale Univ., New Haven). Phys. Rev., A; 2: 707–21(Sep 1970).

A precision redetermination of the fine-structure interval of the ground state of positronium, $\Delta\nu$, was made in an experiment similar to earlier experiments. The frequency difference between the M = ±1 and the M = 0 Zeeman levels of orthopositronium was measured in a static magnetic field of about 7900 G. The dependence of $\Delta\nu$ on gas pressure (argon) was observed for the first time. The result for $\Delta\nu$ is $\Delta\nu_{exp} = (2.034\ 03 \pm 0.000\ 12) \times 10^5$ Mc/sec, where the error quoted is one standard deviation and represents an improvement in accuracy by a factor of 4 compared to earlier work. This value is in reasonable agreement with the theoretical value of $\Delta\nu_{theor} = 2.034\ 27 \times 10^5$ Mc/sec, but a calculation of the α^4-Ry term in the theory is needed. The result for the fractional fine-structure pressure shift is $(1/\Delta\nu)(\partial\Delta\nu/\partial P)_{300°K} = (-0.93 \pm 0.18) \times 10^{-7}$/Torr of Ar, in which a one-standard-deviation statistical error is quoted. This value has the same sign but is 20 times larger than the fractional hfs pressure shift for hydrogen in argon. The experiment also yields the first direct measurement of the parapositronium annihilation rate $\lambda_{p\,expt} = 0.799 \pm 0.011 \times 10^{10}$ sec^{-1}, where a one-standard-deviation error is given. This value is in excellent agreement with the theoretical value of $\lambda_{p\,theor} = 0.798 \times 10^{10}$ sec^{-1}. (auth)

51415 CLASSICAL CASCADE CALCULATIONS FOR K$^-$ MESIC ATOMS. Rook, J. R. (Nuclear Physics Lab., Oxford). Nucl. Phys.; B20: 14–22(1970).

Classical mechanics is used in a calculation of the cascade of K$^-$ mesic atoms, involving x-ray and Auger processes, assuming an initial statistical distribution between the states with different values of the orbital angular-momentum quantum number. It is concluded that the properties of the cascade are not sensitive to the starting point and qualitative agreement with experiment is obtained. A simple explanation of the x-ray selection rules obtained earlier by Martin is also obtained and suggestions are given for the corresponding rules for the Auger process. (auth)

Collision Phenomena

51416 (AEC-tr-7167) MULTIPLE PHOTON IONIZATION OF ATOMS. Delone, N. B.; Keldysh, L. V. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translation of preprint No. 11, from Fourth All-Union Conference of Physics of Electron and Atom Collisions, Riga, September 15–20, 1969. 22p. (CONF-690965–1). Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 24: 28092.

51417 MOLECULAR ELECTRON IONIZATION CROSS SECTIONS AT 70 eV. Beran, J. A.; Kevan, L. (Univ. of Kansas, Lawrence). J. Phys. Chem.; 73: 3866–76(Nov 1969).

Electron ionization cross sections at 70 eV were measured for 62 rare gases, hydrocarbons, fluorocarbons, and halogen-substituted hydrocarbons and fluorocarbons. These results together with previously measured results on other molecular classes were tested against proposed correlations of ionization cross sections with polarizability, diamagnetic susceptibility, and additivity of atomic ionization cross sections. None of these correlations is generally valid but each is valid within a given molecular class. It is striking, however, that there is a single linear correlation with diamagnetic susceptibility for all nonfluorine-substituted compounds. Two empirical equations are developed, based on polarizability and based on modified additivity correlations, which reproduce the experimental cross sections for 98 molecules in a wide variety of molecular classes within average deviations of 3 and 4.5%. (auth)

51418 IONIZATION OF HYDROGEN ATOMS IN SLOW COLLISIONS WITH METASTABLE HELIUM ATOMS He* (2^1S,2^3S). Fujii, Hitoshi; Nakamura, Hiroki; Mori, Masatake (Tokyo Univ.). J. Phys. Soc. Jap.; 29: 1030–40(Oct 1970).

Ionization cross sections of hydrogen atoms by collisions with metastable helium atoms are calculated on the basis of the local complex potential method. Complex potentials are estimated by the valence-bond (VB) method. The results show that the cross sections for He* (2^1S) + H and He* (2^3S) + H are 1.27 a_0^2 and 118 a_0^2, respectively, at the energy of relative motion 0.001 a.u. and that the temperature dependence of the reaction rate in the former case ($\sim T^{1.0}$) is more remarkable than that in the latter ($\sim T^{0.3}$). It is found that the real part of the complex potential plays an important part in these processes. (auth)

51419 NON-METASTABLE PENNING EFFECT IN α-PARTICLE IONIZATION OF INERT GAS MIXTURES. Kubota, Shinzou (St. Paul's Univ., Tokyo). J. Phys. Soc. Jap.; 29: 1017–29(Oct 1970).

An experimental investigation was performed of the ionization yield by α particles in binary gas mixtures over the whole range of mixing ratio. The ionization yield for Ar–N_2 mixture, in which their ionization potentials are almost equal, agrees well numerically with the estimate from the theory proposed by Huber et al. on the assumption that the ionization yield in the individual component gas is proportional to the energy dissipated primarily by the α particle in the gas. An additional ionization yield over the estimate from the theory is observed for He–Ne, Ar–Kr, Ar–Xe, and Kr–Xe mixtures when more than several percent of the second gas is contained in the mixture. This can be interpreted by nonmetastable Penning (NMP) ionization. For a He–Ar mixture, the relative contributions of NMP and metastable Penning processes to the total ionization yield are estimated. (auth)

51420 ANTI-STOKES RAMAN SCATTERING FROM METASTABLE DEUTERIUM ATOMS. Braunlich, P.; Lambropoulos, P. (Bendix Research Labs., Southfield, Mich.). Phys. Rev. Lett.; 25: 986–7(12 Oct 1970).

Anti-Stokes Raman scattering from metastable deuterium atoms was observed. The results obtained are in good agreement with theoretical calculations. (auth)

51421 INELASTIC SCATTERING OF HIGH-ENERGY ELECTRONS BY HELIUM. Vanderpoorten, R. (Univ. Libre, Brussels). Physica; 48: 254-73(25 Aug 1970).

Generalized oscillator strengths and Born cross sections are calculated for electron excitation of the ground state to the $n\,^1S$ ($n = 1, 5$), $n\,^1P$ ($n = 2, 5$), $n\,^1D$ ($n = 3, 5$), $n\,^1F$ ($n = 4, 5$), and $5\,^1G$ states of helium, and from the $2\,^1S$ to the $3\,^1S$, $4\,^1S$, $2\,^1P$, $3\,^1P$, $4\,^1P$, $3\,^1D$, $4\,^1D$, and $4\,^1F$ states, using configuration-interaction wave functions to describe the initial and final states. The results obtained with various formulations of the oscillator strengths are compared, and the effects of correlations in the target are investigated. (auth)

51422 DISSOCIATION OF 10-keV $(HeH)^+$ MOLECULAR IONS. I. PROTON FRAGMENTS. Schopman, J.; Los, J. (FOM-Instituut voor Atoom-en Molecuulfysica, Amsterdam). Physica; 48: 190-216(25 Aug 1970).

The dissociation of the $(HeH)^+$ ion into a proton and a neutral helium atom upon impact with a rare gas atom was studied. The momentum distribution of the proton fragments with respect to the center-of-mass of the molecule was measured for different angles between the molecular axis and the direction of the primary $(HeH)^+$ beam. Measurements were performed at an incident energy of 10 keV in the laboratory system. The measured momentum distribution appeared to be very narrow, which is inconsistent with the idea of electronic excitation and subsequent dissociation. It has been derived by Russek that the polarization forces due to the adiabatic adjustment of the electrons during the collision lead to dissociation into a neutral helium atom and a proton. The predicted dependence of the cross section on the polarizability of the target atom has been confirmed. Another dissociation mechanism must be involved in the background. It causes a very sharp and angle-dependent resonance structure in the cross section as a function of the momentum of the proton fragments. That structure tentatively has been explained as due to different rotational levels belonging to one resonant state, the energy of which lies just above the dissociation limit. (auth)

51423 MODIFIED BORN APPROXIMATION FOR MODERATE-ENERGY ATOMIC AND MOLECULAR COLLISIONS. Russek, A. (FOM-Instituut voor Atoom-en Molecuulfysica, Amsterdam). Physica; 48: 165-89(25 Aug 1970).

A modified Born approximation in which the nuclei are treated exactly as in the usual Born approximation but the electrons are treated in the adiabatic approximation is formulated. The formulation is complete, however, and electronic excitation is incorporated into the theory as deviations from adiabatic behavior. It is shown that for those processes dominated by relatively large impact parameters, the cross section for electronic excitation turns out to be exactly the Born cross section. By use of the modified Born approximation, a new mechanism is predicted for vibrational–rotational excitation and dissociation of molecular systems in collisions with atoms and other molecules. This excitation, which can occur despite adiabatic electronic motion, is caused by stresses set up within the molecule by polarization-induced forces. (auth)

51424 MULTIPLE IONIZATION OF Kr AND Xe BY 2- TO 14-KeV ELECTRONS. El-Sherbini, Th. M.; Van Der Wiel, M. J.; De Heer, F. J. (FOM-Instituut voor Atoom-en Molecuulfysica, Amsterdam). Physica; 48: 157-64(25 Aug 1970).

The relative abundances of multiple charged ions formed by 2- to 14-keV electrons incident on krypton and xenon were measured. Ion selection was performed in a charge analyzer of 100% transmission. The relative abundances of the multiple charged ions obtained were larger than those given by previous investigators. Partial ionization cross sections were determined by normalization on the absolute ionization cross sections of Schram et al. The energy dependence of the partial ionization cross sections was generally in agreement with the Bethe–Born approximation. A good agreement was also obtained between experimental values for the summation of the proportionality constants of the E_{el}^{-1} ln E_{el} terms in the cross sections for all the charges and the values calculated by Kingston from photoabsorption data. (auth)

51425 BEHAVIOR OF EIGENPHASES NEAR A RESONANCE. Macek, Joseph (Univ. of Nebraska, Lincoln). Phys. Rev., A; 2: 1101-3(Sep 1970).

Eigenphases near a resonance are shown to follow an equation that is a simple generalization of the usual equation for the behavior of the phase shift near a resonance in single-channel scattering. The parameters in the equation are shown to have a simple graphical interpretation. (auth)

51426 RESONANCE WIDTHS IN ELECTRON–HEAVY-ATOM SCATTERING. Bottcher, C. (Harvard Coll. Observatory, Cambridge, Mass.). J. Phys., B (London); 3: 1201-10 (Sep 1970).

A general method of estimating the widths of resonances in electron–atom scattering is described. Comparison is made with previous calculations on helium, beryllium, and oxygen. New calculations on carbon and fluorine are presented. Some Rydberg series in helium are discussed. (auth) (UK)

51427 THEORY OF THE EXCITATION OF HYDROGEN BY ELECTRON IMPACT. Rudge, M. R. H. (Queen's Univ., Belfast). Proc. Roy. Soc. (London), Ser. A; 318: 497-506(22 Sep 1970).

A formulation of the electron–hydrogen-atom scattering problem is presented which leads to the description of an excitation process in terms of a set of coupled differential equations. These equations are a considerable simplification over the set of coupled integro-differential equations obtained in the usual close-coupling treatment. Results are presented for the elastic scattering phase shifts calculated in a one-state approximation and in an approximation that partially reflects the effects of coupling through the use of a polarized atomic orbital. The corresponding central potentials of the calculation are also given. It is concluded that the present approach should be a useful one but that convergence for the triplet scattering is likely to prove slower than for the singlet scattering. (auth) (UK)

51428 SYMMETRIZED IMPACT-PARAMETER TREATMENT OF ELECTRON-IMPACT EXCITATION. Jamieson, M. J.; Reid, R. H. G. (Harvard Coll. Observatory, Cambridge, Mass.). J. Phys., B (London); 3: L104-6(Sep 1970).

The merits of the symmetrized impact-parameter equations, which are a restricted form of the semiclassical equations of Bates and Holt (1966), and of the usual impact-parameter equations are explored in calculations of cross sections for electron-impact excitation of hydrogen. Comparison with quantal calculations shows that the symmetrized equations yield more accurate results. (auth) (UK)

51429 SEMICLASSICAL TREATMENT OF 1s–2s EXCITATION IN e–H COLLISIONS. Perrott, R. H. (Queen's Univ., Belfast). J. Phys., B (London); 3: L103-4(Sep 1970).

The total cross section for 1s–2s excitation in e–H collisions was calculated by the impact-parameter and the forced common turning point methods. There is excellent agreement at all energies between the forced common turning point method results and the corresponding close-coupling quantal results obtained by Smith et al. in 1960. (auth) (UK)

51430 THERMAL-ELECTRON SCATTERING BY POLAR MOLECULES. Christophorou, L. G.; Pittman, D. (Oak Ridge National Lab., Tenn.). J. Phys., B (London); 3: 1252-9(Sep 1970).

The temperature dependence of the drift velocity of thermal electrons travelling through polar gases was investigated, and the data were used to determine more accurately the magnitude and the velocity dependence of the momentum-transfer cross section σ_m, expressed as $\sigma_m = A_\alpha/v^\alpha$, where A_α is a constant for each value of α. The values of α for the 14 polar molecules investigated are found to be close to the value of 2 predicted by the Born approximation. There is a considerable spreading in σ_m for permanent electric dipole moments μ in the region $1.65 \lesssim \mu \lesssim 3$ debye. (auth) (UK)

51431 STUDY ON THE COLLISION OF HYDROGEN IONS H_1^+, H_2^+, AND H_3^+ WITH A WATER-VAPOUR TARGET. Dagnac, R.; Blanc, D.; Molina, D. (Univ., Toulouse). J. Phys., B (London); 3: 1239-51(Sep 1970).

The total cross sections of charge exchange and electron loss for energies between 2 and 60 keV were measured. The use of a calorimetric detector permits the determination of the ratio δ_0/δ_+ of the secondary emission coefficient of neutral particles to that of ions for H_1^+, H_2^+, H_3^+, H_2^+, H_3^+, and H_3^+ impinging on a CuO–Be target (electron multiplier cathode). These results make possible absolute measurements for the cross section σ_{10} and σ_{01}. The experimental results are compared with those of other authors; particularly they allow the verification of the additive rule, starting from σ_{10} and σ_{01} values on O_2 and H_2 obtained by other authors. A theoretical treatment was attempted based upon Gryzinski's (1965) theory. (auth) (UK)

51432 SCATTERING CROSS SECTIONS FOR SLOW ELECTRONS IN POLYATOMIC GASES. Singh, Y. (Indian Association for the Cultivation of Science, Calcutta). J. Phys., B (London); 3: 1222-31(Sep 1970).

Momentum transfer and inelastic collision cross sections for electrons in CO, N_2O, and CO_2 were calculated in the energy range

0.01 to 0.1 eV. The effective-range theory and the Born approximation were used to calculate respectively the elastic and inelastic cross sections. The scattering lengths were found to be approximately $-1.12\ a_0$, $-3.7\ a_0$, and $-7.2\ a_0$ for CO, N_2O, and CO_2 respectively. The calculated rotational transition cross section for CO at electron energies below vibrational threshold is in very good agreement with the experimental value. The importance of the quadrupole interaction and the other branches of the potential function is discussed. (auth) (UK)

51433 ANALYTIC CURVE FITS TO HELIUM TRANSITION INTEGRALS. Crothers, D. S. F. (Queen's Univ., Belfast). J. Phys., B (London); 3: 1211-15(Sep 1970).

It is pointed out that helium transition integral, and hence its associated generalized oscillator strength, has eight poles in the q plane, where q is the momentum transfer. They constitute four conjugate pairs lying on the imaginary axis. This analytic behavior is exhibited in the formulae derived by Crothers and McEachran in 1970, whereas the expression assumed by Lassettre in 1965 contains only one pair of poles. The further six poles are directly attributable to the indistinguishability of the bound electrons. The accurate numerical $1\ ^1S \rightarrow 2\ ^1S$ generalized oscillator strengths calculated by Bell et al. in 1969 are curve-fitted by interpolating six of the values with an analytic expression exhibiting the required eight poles, whose orders are partially determined by the requirements of orthogonality and the correct asymptotic fall-off with respect to q. The accurate numerical $1\ ^1S \rightarrow 2\ ^1S$ first Born proton-impact cross sections obtained by Bell et al. in 1968 are reproduced with less than 0.1% error over the entire range (5 to 5000 keV) of proton impact energies. (auth) (UK)

51434 EXCITATION FUNCTION OF THE 6^3P_0 METASTABLE LEVEL OF MERCURY. Korotkov, A. I. Opt. Spectrosc. (USSR) (Engl. Transl.); 28: 347-9(Apr 1970).

Translated from Opt. Spektrosk.; 28: 641-4(Apr 1970).

The excitation function for the $6^3P_0 \rightarrow 6^1S_0$ transition was measured by an electrical method based on recording the kinetic energy of electrons subjected to inelastic collisions of the second kind with metastable mercury atoms. Then, using the Klein and Rosseland relationship, the excitation function was established for inelastic collisions of the first kind, which corresponds to the $6^1S_0 \rightarrow 6^3P_0$ transition. It was found that the excitation function has two fine-structure maxima. (auth)

51435 FADDEEV EQUATIONS FOR ATOMIC PROBLEMS. III. CONVERGENCE OF THE SEPARABLE-EXPANSION METHOD FOR COULOMB INTERACTIONS. Chen, Joseph C. Y.; Chung, Kwong T. (Univ. of California, San Diego, La Jolla). Phys. Rev., A; 2: 1449-57(1 Oct 1970).

The convergence of the separable-expansion method for solving the Faddeev equations is investigated for systems with pure Coulomb interactions between particles in each pair. Two alternative separable expansions for the off-shell two-body amplitudes are utilized. It is observed that the expansion method is capable of predicting qualitatively all the characteristic features such as the three-body bound-state and resonance poles, the scattering length, and the energy dependence of the phase shift in atomic systems such as the (e, H) system. Although some convergence behavior is observed, this method in the present form does not provide the desired accuracy when reasonable numbers of terms are included in the expansion for the attractive (e–p) scattering amplitudes. This behavior is interpreted as due to the failure of the two alternative expansions for the off-shell two-body amplitudes to converge monotonically. (auth)

51436 TOTAL CROSS SECTION FOR CHARGE TRANSFER OF NOBLE-GAS IONS IN N_2. Lockwood, Grant J. (Sandia Labs., Albuquerque, N. Mex.). Phys. Rev., A; 2: 1406-10 (1 Oct 1970).

Absolute measurements are reported of the total cross section σ_{10} for charge transfer of He^+, Ne^+, Ar^+, Kr^+, and Xe^+ in N_2 in the energy range from 10 to 100 keV. These measurements were obtained with ions produced in both an rf ion source and an electron-impact ion source. Differences are observed in the measured cross sections obtained with the different sources, except for Ne^+. These differences are attributed to metastable ions produced in the rf source. (Note: Ne^+ has no known metastable states.) The largest difference occurs with Xe^+ ions, where the ratio of the two measurements is 1.5 at a velocity of 2×10^7 cm/sec. In addition, a peak in the Xe^+ cross sections obtained with the rf ion source is not present in data taken with the electron-impact source. It is believed that the peak is caused by the near-resonant charge transfer that can occur between metastable Xe^+ and dissociative ionization of N_2 or with excitation of N_2^+ to the $C^2\Sigma_u^+$ state. (auth)

51437 STUDY OF e–H_2 SCATTERING NEAR THE ROTATIONAL THRESHOLD. Chang, Edward S. (Univ. of Chicago). Phys. Rev., A; 2: 1403-6(1 Oct 1970).

Attention is called to the remarkable agreement between a recent experiment and the Gerjuoy–Stein theory based on the Born approximation for the rotational excitation of H_2 near threshold. The comparison is conducted through partial-wave analysis and application of the Wigner threshold law. (auth)

51438 AUGER ELECTRONS FROM ARGON WITH ENERGIES 150 TO 210 eV PRODUCED BY H^+ AND H_2^+ IMPACTS. Volz, D. J.; Rudd, M. E. (Univ. of Nebraska, Lincoln). Phys. Rev., A; 2: 1395-1403(1 Oct 1970).

Secondary electrons in the energy range 150 to 210 eV produced by 125- to 300-keV H^+ and H_2^+ impacts on argon gas are measured as a function of their energy and angle of emission. Discrete line spectra are due to Auger transitions from L_2 and L_3 vacancy states as well as satellite transitions from multivacancy states. The widths, energies, and branching ratios of the L_2 and L_3 vacancy states are presented. Widths of these states are appreciably greater than those obtained with electron-impact excitation. This can be attributed to the recoil velocities of the target atom and to the presence of the proton in the vicinity of the emitting atom. The angular distribution of Auger electrons is found to be nearly isotropic, in marked contrast to electrons in the continuum spectrum. The cross sections for the production of $L_{2,3}$ and L_3 vacancy states are determined as a function of impact energy. (auth)

51439 VIBRATIONAL EXCITATION OF H_2 BY LOW-ENERGY ELECTRONS. Crompton, R. W.; Gibson, D. K.; Robertson, A. G. (Australian National Univ., Canberra). Phys. Rev., A; 2: 1386-95(1 Oct 1970).

The $v = 0 \rightarrow 1$ vibrational cross section for H_2 derived from swarm experiments is shown to be a good approximation to the sum of the cross sections for vibrational transitions that take place with and without simultaneous rotational excitation of the molecule. Experiments are described that prove that this summed cross section does not depend on whether the H_2 molecules are in the $J = 0$ or the $J = 1$ rotational state, in agreement with a recent theoretical calculation. Reasons are given for the disagreement between the two published swarm-derived vibrational cross sections. However, the discrepancies between the threshold behavior of the cross sections determined by the swarm measurements, beam experiments, and theory have not yet been explained. (auth)

51440 MEASUREMENT OF CHARGE-CHANGING CROSS SECTIONS FOR 0.4- TO 4.0-MeV ALUMINUM IONS IN NITROGEN. Ryding, G. (High Voltage Engineering Corp., Burlington, Mass.); Wittkower, A.; Nussbaum, G.; Saxman, A.; Rose, P. H. Phys. Rev., A; 2: 1382-5(1 Oct 1970).

Absolute cross sections for single- and multiple-electron capture and loss by fast aluminum ions in collisions with N_2 gas molecules were measured. Data were taken at nine projectile energies between 0.4 and 4.0 MeV, for several incident charge states at each energy. Cross sections were determined from the initial behavior of charge-fraction growth curves under thin-target conditions. (auth)

51441 COUPLED-STATE IMPACT-PARAMETER METHOD FOR ELECTRON EXCITATION OF ATOMS. I. HYDROGEN THROUGH $n = 3$ LEVELS. Mandelberg, Hirsch I. (Lab. for Physical Sciences, College Park, Md.). Phys. Rev., A; 2: 1372-82(1 Oct 1970).

The semiclassical impact-parameter treatment of the electron excitation of atoms yields a set of coupled first-order linear differential equations, which have been solved by previous authors in first-order perturbation theory. The present results utilize an approximate solution of the full set of coupled equations, employing the dipole approximation of Seaton. Results are described applying this method to electron excitation of hydrogen, coupling together the (n, l, m) states through $n = 3$, and these results are compared with those of quantum mechanical close-coupling calculations. The agreement indicates the general utility of this method. (auth)

51442 DELAYED-COINCIDENCE STUDY OF $O^+ + Ne$ COLLISIONS AT 50 TO 200 keV. Bingham, Felton W. (Sandia Labs., Albuquerque, N. Mex.). Phys. Rev., A; 2: 1365-71 (1 Oct 1970).

Delayed-coincidence techniques have provided measurements of the distributions in values of Q, the energy transferred to inelastic processes, during $O^+ + Ne$ collisions at 50 to 200 keV. The average values $\bar{Q}$ of the Q distributions remain almost constant as a function of r_0, the distance of closest approach of the colliding particles. For fixed r_0, the $\bar{Q}$ values vary slowly with bombarding energy and lie, for example, approximately 40 eV

higher at 100 keV than at 50 keV. The flatness of the $\bar{Q}(r_0)$ functions is reflected in a similar independence of r_0 found in measurements of the average charges of the particles after collision. These results indicate that the collisions produce excitations only among L-shell electrons. However, some data describing the widths of certain Q distributions indicate that K-shell excitations may occur infrequently among collisions that produce O^{+4} ions. Supplementing the data for inelastic energy transfers are determinations of average ionic charge states after collision, measurements of angular-distributions of scattering cross sections, and calculations of inelastic energy-loss cross sections deduced from the $\bar{Q}$ data. (auth)

51443 VIBRATIONAL AND ROTATIONAL EXCITATION OF MOLECULAR HYDROGEN BY ELECTRON IMPACT. Henry, Ronald J. W. (Louisiana State Univ., Baton Rouge). Phys. Rev., A; 2: 1349-58(1 Oct 1970).

The close-coupling approximation is used to calculate integral and differential cross sections for pure vibrational excitation $\sigma(v = 0 \rightarrow 1, \Delta j = 0)$ and $\sigma(v = 0 \rightarrow 2, \Delta j = 0)$, and for simultaneous rotational–vibrational excitation $\sigma(v = 0 \rightarrow 1, \Delta j = 2)$ of H_2 by slow-electron impact. Static-field and electron-exchange effects, long-range quadrupole, and an effective polarization potential are included in the $e-H_2$ interaction. Pure vibrational cross sections are found to depend on the initial rotational state j of the molecule, but the total vibrational cross section is almost independent of j. Cross sections are compared with experiments for energies $E \leq 10$ eV. For $2 < E < 5$ eV, $\sigma(v = 0 \rightarrow 1, \Delta j = 0)$ and $\sigma(v = 0 \rightarrow 1, j = 1 \rightarrow 3)$ are 50% larger than experimental values while agreement is better in the remaining energy regions. For $1 < E < 3$ eV, $\sigma(v = 0 \rightarrow 2, \Delta j = 0)$ is in good agreement with experiment but is underestimated for $E > 3$ eV. Differential scattering cross sections for vibrational excitation are found to be dominated by the polarization at low angles and by the short-range potential at large angles. (auth)

51444 TOTAL CROSS SECTIONS FOR EXCITATION OF TRIPLET STATES IN MOLECULAR NITROGEN. Cartwright, D. C. (Univ. of Colorado, Boulder. Aerospace Corp., Los Angeles). Phys. Rev., A; 2: 1331-48(1 Oct 1970).

A consistent set of total cross sections for electron-impact excitation of the $A^3\Sigma_u^+$, $B^3\Pi_g$, $W^3\Delta_u$, $B'^3\Sigma_u^-$, $C^3\Pi_u$, $E^3\Sigma_g^+$, and $D^3\Sigma_u^+$ triplet states of molecular nitrogen from the $X^1\Sigma_g^+$ state was calculated quantum mechanically for incident-electron energies from threshold to 80 eV. The Ochkur–Rudge exchange scattering and Franck–Condon approximations were employed to obtain these cross sections. Minimum and double-minimum basis-set LCAO–MO wave functions centered on the nuclei were used, and the multicenter terms in the scattering amplitude were evaluated using a ξ-function expansion. Rotationally averaged cross sections were calculated for excitation from $v'' = 0$ to individual v' levels of the excited electronic states. The calculated total cross section for excitation of the $B^3\Pi_g$ state is in good agreement with that deduced from recent experimental data for the process. The cross section for excitation of the $C^3\Pi_u$ state agrees well with one pair of experimental measurements and is a factor of 2 larger than another pair of measurements and about a factor of 4 larger than a fifth experimental determination and the previous calculations. The calculated cross section for excitation of the $A^3\Sigma_u^+$ state is a good deal larger than previous theoretical and experimental estimates. However, a comparison with recent experimental differential-cross-section data indicates that the theoretical $A^3\Sigma_u^+$ total cross section is correct for incident energies greater than about 35 eV. The relative magnitude of these excitation cross sections leads to interesting predictions concerning N_2 processes in the upper atmosphere. (auth)

51445 EMISSION OF AUGER ELECTRONS RESULTING FROM SYMMETRIC ARGON AND NEON ION–ATOM COLLISIONS. Cacak, R. K. (Univ. of Nebraska, Lincoln); Kessel, Q. C.; Rudd, M. E. Phys. Rev., A; 2: 1327-31(1 Oct 1970).

Cross sections for the emission of Auger electrons from excited atoms and ions produced in symmetric Ar^+-Ar and Ne^+-Ne collisions were measured at ion energies from 50 to 300 keV. A simple model is proposed to explain the dependence of the cross section on the impact energy; the predicted results agree well with the experiment. Also, the argon x-ray data of Saris and Onderdelinden are compared with the model and with the results of this experiment. (auth)

51446 ABSOLUTE DOUBLY DIFFERENTIAL CROSS SECTIONS FOR PRODUCTION OF ELECTRONS IN Ne^+–Ne AND Ar^+–Ar COLLISIONS. Cacak, R. K.; Jorgensen, T. Jr. (Univ. of Nebraska, Lincoln). Phys. Rev., A; 2: 1322-7 (1 Oct 1970).

Absolute differential cross sections for the production of electrons by collisions of neon ions with a neon-gas target and argon ions with an argon-gas target were measured. The cross sections were doubly differential in angle and energy of the ejected electrons. The energy range of the primary ions was 50 to 300 keV. Electrons produced by the ion–atom collisions were analyzed in angle and energy, counted, and, from a knowledge of the other parameters of the apparatus, an absolute cross section was determined. The experimental results show some structure in the electron-energy spectra superimposed on a continuous background. This is consistent with the predictions of the Fano–Lichten electron-promotion model. Calculations based on the results of the Russek statistical model are compared with experiment. (auth)

51447 EXPERIMENTAL AND THEORETICAL STUDIES OF ELECTRON-IMPACT EXCITATION OF NEON. Sharpton, Francis A. (Olivet Nazarene Coll., Kankakee, Ill.); St. John, Robert M.; Lin, Chun C.; Fajen, Fredric E. Phys. Rev., A; 2: 1305-22(1 Oct 1970).

The electron excitation functions of some fifty states from the $2p^5ns$, $2p^5np$, and $2p^5nd$ configurations were measured by the optical method. Corrections due to cascade from the upper levels are important only for the np states and typically amount to 50% of the total population. The scheme of characterizing the excitation behaviors of helium by the quantum numbers L and S of the states can be carried over to neon if one expresses the wave functions of the excited states of neon in terms of the LS eigenfunctions. For example, all the optically allowed states exhibit very broad excitation functions and large cross sections, and the purely triplet states have narrow excitation functions. For the other states, the wave functions are expressible as linear combinations of those of triplet states and dipole-forbidden singlet states; hence, the excitation functions have intermediate widths. From group-theoretical arguments, it is shown that within a configuration $2p^5nl$, the states with odd values of $J + 1$ have larger excitation cross sections than the ones with even values. This theoretical rule was well confirmed by our experimental data. In addition, it is deduced theoretically that $Q(J = 0) > Q(J = 2)$ for the np states, and $Q(J = 1) > Q(J = 3)$ for nd; and in a more restricted way, that $Q(J = 1) > Q(J = 3)$ for np and $Q(J = 2) > Q(J = 0, 4)$ for nd. These relations are in good agreement with experiment with only a few exceptions. Most of the qualitative and semiquantitative features of the experimental data can be understood from generalization of the results of helium and by simple theoretical considerations. The excitation cross sections of the states with odd values of $J + 1$ were calculated by the Born approximation using atomic wave functions constructed by the Hartree–Fock–Slater orbitals, together with a semiempirical treatment of the intermediate vector coupling. The agreement between the theoretical and experimental values is generally satisfactory. The even-$(J + 1)$ states are strongly influenced by indirect coupling; thus, no attempt was made to compare the experimental data of these states with the Born-approximation calculations. (auth)

51448 ANGULAR DISTRIBUTION OF PROTONS AND DEUTERONS PRODUCED BY DISSOCIATIVE IONIZATION OF H_2 AND D_2 NEAR THRESHOLD. Van Brunt, R. J.; Kieffer, L. J. (Univ. of Colorado, Boulder). Phys. Rev., A; 2: 1293-1304(1 Oct 1970).

From observations of the kinetic-energy distribution of protons and deuterons at corresponding forward and backward angles with respect to the electron-beam direction, the forward momentum imparted to the dissociating H_2 (D_2) molecule by the incident electron was determined for electron energies up to 300 eV. The momentum transfer along the beam was found to remain nearly constant at all energies above threshold, although above 100 eV the values obtained for D_2 were systematically higher than the values for H_2. When corrected to the center-of-mass system, the angular distribution of H^+ (D^+) near threshold was found to contain a large isotropic component and an anisotropic component that deviates, in a manner suggested by Zare, from the $\cos^2\theta$ dependence predicted from a simple dipole Born approximation. (auth)

51449 OPACITY ANALYSIS OF INELASTIC MOLECULAR COLLISIONS. COMPUTATIONAL STUDIES OF THE EXPONENTIAL BORN APPROXIMATION FOR ROTATIONAL EXCITATION. Balint-Kurti, G. G.; Levine, R. D. (Hebrew Univ., Jerusalem). Chem. Phys. Lett.; 7: 107-11(1 Oct 1970).

The exponential Born approximation is used to compute S matrices and opacities for rotational transitions in a model system corresponding to a heavy-atom–heavy-diatomic collision. The results are in good agreement with the exact calculations in the limited coupling region. The use of the exponential Born approximation, together with a statistical approximation for regions of

low angular momentum, makes possible the practical computation of cross sections for inelastic rotational transitions. (auth)

51450 POLARIZATION EFFECTS IN THE PHOTOABSORPTION CROSS SECTION OF ATOMIC HELIUM. Wendin, G. (Inst. of Theoretical Physics, Goteborg). Phys. Lett.; 33A: 16-17(21 Sep 1970).

Correlation effects are found to be important in the photoabsorption spectrum of the helium atom. A correct treatment of the random phase approximation results in good agreement with experiments. (auth)

51451 FORMATION OF HIGHLY EXCITED NEUTRAL ATOMS BY CHARGE EXCHANGE FROM ALKALI TARGETS OF ARBITRARY THICKNESS. Lodge, J. G. (York Univ., Toronto); May, R. M. Aust. J. Phys.; 23: 481-90(Aug 1970).

Results are presented for the population of highly excited H atoms in the final outgoing beam formed when an incident beam of protons is passed through a neutralizing target of H, Li, or Na. Targets of arbitrary thickness ρ are considered, where ρ is the product of the actual target width and the density of neutral atoms within it; the cases of thin and thick targets are obtained as limits of the general expressions. Recently available accurate cross sections for the relevant charge transfer and ionization processes are used in the calculations. Where possible, results are compared with experiment. (auth) (Australia)

51452 ELECTRONIC EXCITATION TRANSFER BETWEEN ATOMIC AND MOLECULAR HYDROGEN. Chow, K. W.; Smith, A. L. (Yale Univ., New Haven). Chem. Phys. Lett.; 7: 127-31(1 Oct 1970).

The process $H^*(2p) + H_2(X) = H(1s) + H_2^*(B)$ has been observed in a fluorescence experiment. The vibrational distribution in $H_2(B)$ is broad. A mechanism involving an $H^+ - H_2^-$ intermediate is discussed. (auth)

Atomic Theory

51453 IDENTITIES RELATING SPIN–SPIN AND ORBIT–ORBIT TO SPIN–ORBIT INTERACTIONS. Matcha, R. L. (Univ. of Houston, Tex.); Kern, C. W. Phys. Rev. Lett.; 25: 981-2 (12 Oct 1970).

Identities that express spin–spin and orbit–orbit interactions in terms of two-electron spin–orbit matrix elements are derived. They can reduce, in effect, any study of the two-electron Breit–Pauli Hamiltonian for atoms or molecules to one of determining the spin–orbit integrals, thereby considerably unifying and simplifying the whole analysis. (auth)

51454 RELATIVISTIC AUGER EFFECT PROBABILITIES FOR K–LM AND K–MM TRANSITIONS. Bhalla, C. P.; Rosner, H. R.; Ramsdale, D. J. (Kansas State Univ., Manhattan). J. Phys., B (London); 3: 1232-8(Sep 1970).

Theoretical rates for the K–LM and K–MM Auger transitions are presented over a wide Z range. The relativistic transition operator is used. The relativistic Hartree–Fock–Slater atomic model is employed. (auth) (UK)

51455 CALCULATION OF LINE STRENGTHS FROM LIFETIMES OF EXCITED STATES. Semyonov, R. I. Opt. Spectrosc. (USSR) (Engl. Transl.); 28: 341-4(Apr 1970).

Translated from Opt. Spektrosk.; 28: 630-5(Apr 1970).

A method is proposed for calculating line strengths from the radiative lifetimes of excited states. Calculations are carried out for atoms with two outer electrons in the one-configuration approximation. Line strengths are calculated for the transitions between the $2p^53s$ and $2p^53p$ configurations of Ne I beginning on the $J = 0$ and $J = 3$ levels. The results are compared with values of the line strengths obtained by other methods. (auth)

51456 RELATIVISTIC CORRECTIONS TO THE LEVELS OF MULTI-ELECTRON ATOMS IN THE SELF-CONSISTENT-FIELD APPROXIMATION. Braun, M. A.; Dmitriev, Yu. Yu.; Labzovskii, L. N. Opt. Spectrosc. (USSR) (Engl. Transl.); 28: 332-3(Apr 1970).

Translated from Opt. Spektrosk.; 28: 612-14(Apr 1970).

Expressions for relativistic corrections of orders α^2 Ry and α^3 Ry to the levels of multi-electron atoms were obtained using a relativistic approximation of the self-consistent-field method. For calculating the expression containing "Bethe's logarithm," the variational principle was used. (auth)

51457 CUSP CONSTRAINTS FOR ATOMIC WAVE FUNCTIONS. Chapman, J. A.; Chong, D. P. (Univ. of British Columbia, Vancouver). Can. J. Chem.; 48: 2722-6(1 Sep 1970).

A hierarchy of cusp constraints, from necessary to sufficient, is examined. A flexible approach of cusp-satisfying orbitals is proposed. This is tested on some simple wave functions for the ground state of lithium. It is found that cusp-satisfying wave functions give good values for the spin as well as electron densities at the nucleus. (auth) (Canada)

51458 SUPERRADIANT INTENSITY FLUCTUATIONS. Eberly, Joseph H.; Rehler, Nicholas E. (Univ. of Rochester, N. Y.). Phys. Rev., A; 2: 1607-10(1 Oct 1970).

A new approach to the problem of superradiant spontaneous emission, which is applicable whether the number of atoms is large or small, is described. This approach is used to formulate intensity correlations of arbitrary order, and then explicitly evaluate the second-order normally ordered relative intensity fluctuation. Large fluctuations at the onset of emission indicate the discrete nature of the spontaneous emission process; and the very small fluctuations found later at the emission peak show that the emitting process has by then become essentially classical. (auth)

51459 NUCLEAR MASS CORRECTIONS TO THE ELECTRON g FACTOR. Grotch, H. (Pennsylvania State Univ., University Park). Phys. Rev., A; 2: 1605-7(1 Oct 1970).

Additional correction terms of order $(Z\alpha)^2 m/M$ are found for the electron g factor in the ground state of hydrogenic atoms. This modifies earlier results given by Hegstrom and by this author. (auth)

51460 TWO USES OF R_4 IN THE STUDY OF ATOMIC STRUCTURE. Alper, J. S. (Univ. of Massachusetts, Boston). Phys. Rev., A; 2: 1603-5(1 Oct 1970).

The two different uses of R_4, one as a mathematical and one as physical group, which were discussed in previous work, are presented. The treatment of Rau is shown to be equivalent to the mathematical approach. The use of the physical group leads to new relationships not present in the mathematical approach. (auth)

51461 COMMENTS ON THE ALLEGED VALIDITY OF R_4 INVARIANCE AS A SYMMETRY FOR ELECTRON CORRELATIONS. Rau, A. R. P. (Univ. of Chicago). Phys. Rev., A; 2: 1600-3(1 Oct 1970).

Recent indications that R_4 is a fairly good symmetry for two-electron atoms are shown to be unjustified. (auth)

51462 MODIFIED QUANTUM-STATISTICAL CALCULATIONS FOR ATOMIC ELECTRON DENSITIES. Goodisman, Jerry (Syracuse Univ., N. Y.). Phys. Rev., A; 2: 1193-9 (1 Oct 1970).

An attempt is made to overcome one of the shortcomings in the Thomas–Fermi and related theories for atoms by connecting a quantum-mechanical electron density for the region near the nucleus to a density given by a statistical model. The joining may be done in a nonarbitrary manner. All parameters are determined. It suffices to use a very crude and easily calculated approximation to the density to start with, so the calculation is quite easy. The resulting electron density is in much better agreement with reality than that from the unmodified theories. (auth)

Cosmic Radiation

Refer also to abstracts 51308, 51514, and 51987.

51463 (N-70-23988) SPACE PHYSICS GROUP QUARTERLY STATUS REPORT. (Wisconsin Univ., Madison). Mar 1970. Contract NAS5-11068. 13p. (NASA-CR-109455). NTIS.

The results of the calibration work on the prototype gamma-ray detector for OSO-B are briefly summarized. The intensity and galactic distribution of gamma rays from the galactic anticenter are explained by two assumptions: (1) the interstellar gas density is as implied by 21-cm hydrogen line emission studies. (2) the cosmic-ray intensity if the galactic disc at distances greater than 10 kpc from the center is the same as it is near the solar system. Other investigations include: rocket x ray, OSO-A x ray, S-150 x ray, galactic atomic hydrogen, and deuterium composition of the solar wind. (STAR)

51464 (N-70-28733) PRIMARY COSMIC-RAY POSITRONS AND NEGATRONS IN 1968 AT ENERGIES BETWEEN 11 AND 204 MeV. Rice, Carl James (California Inst. of Tech., Pasadena). Feb 1970. 176p. (NASA-CR-110192; SRL-70-1). NTIS. Thesis.

The cosmic-ray positron and negatron spectra between 11 and 204 MeV were measured in a series of high-altitude balloon flights. The detector system consisted of a magnetic spectrometer utiliz-

ing a 1000-gauss permanent magnet, scintillation counters, and a lucite Cherenkov counter. Launches were timed so that the ascent through the 100 g/cm² level of residual atmosphere occurred after the evening geomagnetic cutoff transition. Data gathered during ascent are used to correct for the contribution of atmospheric secondary electrons to the flux measured at float altitude. All flights floated near 2.4 g/cm² residual atmosphere throughout the nighttime interval. A pronounced morning intensity increase was observed in each flight. Daytime positron and negatron data are presented which support the interpretation of the diurnal flux variation as a change in the local geomagnetic cutoff. (STAR)

51465 (N-70-29867) COSMIC RAYS AND THEIR INTERACTIONS. Murzin, V. S.; (and others). Translation of Kosmicheskie Luchi i Ikh Vzaimodeystvie, Atom Press, Moscow, 1968. 333p. (NASA-TT-F-594). NTIS.

The experimental material on the nuclear interactions between particles of cosmic radiation is discussed. An analysis is made of the characteristics of the elementary nuclear interaction process in the energy range from 10 to 100,000 GeV and of the methodology of experiments on cosmic rays. Considerable attention is given to an examination of the reliability of experimental results. The cross section of the interaction of nuclear-active particles and the multiplicity, nature, and energetic and angular characteristics of secondary particles are considered. The data were obtained either by direct registration of the nuclear interactions of particles or by the study of the secondary phenomena created by particles of super-high energy in the atmosphere. A comparison is made between the characteristics obtained experimentally and theoretical models. (auth) (STAR)

51466 COSMOGENIC RADIONUCLIDE PRODUCTION RATES IN ARGON IN THE STRATOSPHERE. Young, J. A.; Thomas, C. W.; Wogman, N. A. (Battelle Memorial Inst., Richland, Wash.). Nature (London); 227: 160-1(11 Jul 1970).

Spallation reactions of cosmic rays with atmospheric Ar produce radionuclides with half-lives ranging from seconds to millions of years, and a list is given of such nuclides observed to date. Over a period of 3 years air filter samples obtained by aircraft and ground level air pumps were collected in order to determine radionuclide concentrations in the atmosphere, the primary purpose being to study atmospheric precipitation scavenging mechanisms. The cosmogenic radionuclides ^{24}Na, ^{39}Cl, and ^{38}Cl were found very useful in determining the parameters involved in several atmospheric processes, and their concentrations were determined in air as a function of latitude and altitude. In order to determine whether the measured cosmogenic air activities corresponded to the actual cosmogenic production rates a number of metal spheres containing Ar were flown at 19.8 km on May 16, 1969 and at 18.3 km on August 28 and October 28, 1969, and the filters were subjected to gamma spectrometric analysis. The techniques of collection and analysis are described in detail. In addition to ^{24}Na, ^{38}Cl, and ^{39}Cl the cosmogenic radionuclides ^{18}F, ^{28}Mg, ^{34m}Cl, and ^{35}S were measured for the August flight. The observed production rates are given in tabular form. Also shown in tabular form is the relative semi-empirical cross section of these nuclides from the proton spallation of Ar. The ratios of the production rates correspond to the ratios expected for ~280 MeV proton spallation of Ar, indicating that this is the average energy of the spallating components producing the cosmogonic radionuclides in the argon spheres near 18 km. To a first approximation the ratios of the production rates do not vary with latitude, altitude, or time, and the actual rates can be applied to studies of atmospheric circulation, scavenging, and the physics of cloud precipitation. The cosmogenic radionuclides from atmospheric Ar are unique in that their half-lives are of the same order of magnitude as the time scale on which precipitation processes occur and therefore provide excellent tracers for measuring the parameters involved in storm formation. Cosmogenic ^{34m}Cl, ^{38}Cl, ^{39}Cl, ^{35}S, and ^{24}Na also serve as excellent natural tracers of particulates involved in precipitation scavenging within clouds. Radionuclides such as ^{25}Na, ^{40}Cl, and ^{37}S can be used in the study of below cloud scavenging. In-cloud nucleation times can be estimated by measuring the ^{39}Cl/^{38}Cl concentration ratio in rain. (UK)

51467 ENERGY SPECTRUM OF NEUTRONS IN COSMIC RADIATION OF 10^{11} TO 10^{12} eV AT SEA LEVEL. Grigorov, N. L.; Mamidzhanyan, E. A. (Moscow State Univ. Erevan Inst. of Physics). Izv. Akad. Nauk. Arm. SSR, Ser. Fiz.; 4: 142-6(1969). (In Russian).

A theoretical study was made to predict the energy spectrum of neutrons in the sea-level cosmic radiation in the energy range 10^2 to 5×10^3 GeV. The expected sea-level spectrum was calculated from the primary spectra obtained from measurements with the Proton satellites. The differential spectrum of neutrons can be represented by $Fn(E)\,dE = 5.2 \times 10^{-10}\,(100/E)^{\beta\Delta}\,dE$ cm^{-2} sec^{-1} ster^{-1} GeV^{-1}. (auth)

51468 LOW ENERGY GAMMA-RAY SPECTRUM IN SPACE. Anand, K. C.; Joseph, George; Lavakare, P. J. (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sect. A; 71: 225-9(May 1970).

Balloon, satellite, and other deep space probe observations on the intensity of low-energy (0.1 to 10 MeV) gamma rays are carefully examined with a veiw to understand the existing anomalies in their intensities and energy spectra. The observed spectral data are "unfolded" to deduce the true gamma-ray energy spectrum. The recently observed flattening in the spectral shape at about 1 MeV is shown to be likely to arise as a result of the gamma-ray detector response to a simple power law input spectrum. (auth)

51469 THRESHOLD RIGIDITY CHANGE DURING THE MAGNETIC STORM OF MARCH 23-24, 1969. Wolfson, C. J.; Nobles, R. A. (Lockheed Palo Alto Research Labs., Calif.). J. Geophys. Res.; 75: 5553-8(1 Oct 1970).

The intensity increase recorded by the White Mountain neutron multiplicity monitor, coincident with the magnetic storm of March 23-24, 1969, is analyzed. The resultant multiplicity spectrum variation is very steep and is probably the result of a temporary threshold rigidity decrease from 4.48 to 3.72 GV at White Mountain. (auth)

Direct Energy Conversion

51470 (AD-707420) STUDY OF NUCLEAR SEEDED MHD PLASMAS. Yearly Summary Technical Report No. 4, December 1, 1968-November 30, 1969. Ellis, William H. (Florida Univ., Gainesville. Dept. of Nuclear Engineering Sciences). 30 Nov 1969. Contract Nonr-580(18). 214p. NTIS.

Mathematical models, formulated to describe the ion current and anode voltage characteristics of pulsed ionization chambers used in kinetic studies of nuclear-generated MHD plasmas, were experimentally verified. Equations resulting from the theory, and relating the voltage signal pulse profiles to initial plasma densities, were used to determine plasma production and loss coefficients for a range of ^{3}He gas pressures from 1 to 10 atmospheres. The results, which are presented, were found to be in good agreement with existing kinetic theories. The results of a numerical parametric study of ionization column dynamics in high-pressure gases, including diffusion, recombination, intercolumn mixing and their temperature and pressure dependence, are presented in graphical and tabular form for a wide range of temperatures and pressures. (auth) (USGRDR)

51471 (AD-707803) OPTIMIZATION OF A LINEAR NON-EQUILIBRIUM MHD GENERATOR. Zauderer, B. (General Electric Co., Philadelphia, Pa. Space Div.). Jun 1970. Contract Nonr-3867(00). 22p. (TR-15). NTIS.

Based on the results of an experimental study of a supersonic, nonequilibrium MHD generator, a theoretical optimization of such a generator was performed. It was found that neon seeded with less than 0.1% cesium was the optimum generator working fluid. The maximum generator power output and efficiency was obtained in a constant-current-density generator operating with a favorable pressure gradient. The optimum channel geometry had an exit to entrance area ratio of about six, linearly diverging channel walls, and a length-to-average-diameter ratio of about ten. It was also found that a constant-velocity generator with a linearly diverging channel geometry had a very low generator conversion efficiency. (auth) (USGRDR)

51472 (CEA-N-1347) DATA ACQUISITION AND PROCESSING PROGRAM FOR THERMIONIC DIODES PARAMETERS, ON A PDP 8-I COMPUTER. Colomes, Jacques; Alleau, Thierry (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Oct 1970. 33p. (In French). Dep. CFSTI (U. S. Sales Only).

A PDP 8-I computer is connected to thermionic diodes test benches. It is fitted with the following equipment: a high-speed perforated tape reader and punch, a teletype teleprinter, digital clocks, and an A/D converter multiplexer system. The PATIO-1 program is written with the ION interrupt facility, and allows the acquisition, the processing and the printing of the data taken from the diodes and collected on the cross bar channels. An initialization is necessary to provide the program with various data such as: the hour, the scanning period, the multiplexer microinstructions, the processing microinstructions for every parameter, some rectifying coefficients, and the diode numbers. The switch register is used to point out to the program which diode is to be scanned, and in which form the results have to be written. (France)

51473 (CEA-R-4062) MATERIALS AND STRUCTURES USED FOR NOZZLES IN MAGNETOHYDRODYNAMIC CONVERSION OF THERMAL ENERGY OF BURNING GASES TO ELECTRICAL ENERGY. Yerouchalmi, David (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Oct 1970. 141p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Paris Univ., Orsay (France). Faculte des Sciences.

Direct power conversion by magnetohydrodynamics of thermal energy into electrical energy is defined by the appropriate hot-gas thermodynamic cycles. Only a nozzle-type generator operating in an open cycle was considered. The operating conditions to which both the conducting and insulating walls of the nozzle were initially subjected changed in an unpredictable manner as the cycle became established. An intermediate temperature (2000°C) between the hot and cold walls was achieved by regulating the wall temperatures. Various additional phenomena such as: solid-state electrolysis, vaporization, and corrosion by alkali seed migration were studied. The electrodes ZrO_2/rare earths and ZrO_2/rare earths + lanthanum chromites were studied in particular. Mechanical cooling devices, cold electric junctions, and current relays were investigated. (France)

51474 (N-70-29169) MAGNETOHYDRODYNAMIC INDUCTION GENERATOR EXPERIMENTAL STUDY. Final Technical Report. (Illinois Univ., Chicago). 15 Apr 1970. Contracts NAS7-100; JPL-952453. 45p. (NASA-CR-110154). NTIS.

For Jet Propulsion Lab., Pasadena, Calif.

The results of an experimental study of a one-wavelength MHD induction generator operating on a liquid flow are presented. The design philosophy and the experimental generator design are briefly summarized, including a description of the flow loop and instrumentation. The measurements without the fluid or fluid channel are given followed by the results obtained for the fluid flow without the magnetic field. Various generator test results are presented, including normal operation when excited from the 60-Hz power line, and operation from the power line with the end coils shorted to reduce magnetic fringing. Both cases were also operated in the self-excited mode with external capacitors to supply the required reactive power. The harmonic content of the terminal voltage was measured, hypothetical accidents simulated, and two-wavelength tests performed. (auth) (STAR)

51475 (UCRL-72411) DIRECT CONVERSION OF FUSION ENERGY TO ELECTRICITY. Post, R. F. (California Univ., Livermore. Lawrence Radiation Lab.). 14 Sep 1970. 11p. (CONF-700912-5). Dep. NTIS.

From 5th Annual Intersociety Energy Conversion Engineering Conference, Las Vegas, Nev.

Among the several fusion reactions that might be utilized to produce fusion power are some where most or all of the energy released appears as kinetic energy of charged reaction products. Under the proper circumstances these reaction products will remain trapped within the reactor and will share energy, via collision processes, with the reacting plasma. Consequently, plasma ions and electrons diffusing out of the confinement zone carry not only kinetic energy imparted by the injection and heating processes employed but also energy derived from the fusion reactions. A method is described for the direct conversion to HVDC, at high efficiency, of energy from charged particle streams emerging from the fusion reactions. The method involves four steps: 1) expansion in static magnetic fields to convert rotational energy components to longitudinal and to reduce the particle stream density; 2) separation of ions and electrons; 3) electrostatic deceleration and selective collection of the separated particle streams to produce dc currents; and 4) reduction of recovered energy to common dc potential for use as HVDC. Theoretical analyses of the overall characteristics of such a system indicate high overall conversion efficiency (90% or greater) and potentially low capital cost per kWe. The possible application of such systems to mirror machines and other types of fusion reactors is discussed, as well as some results from small-scale experiments testing the principles involved. (auth)

51476 SOLVING OF SOME PROBLEMS ABOUT ELECTROMAGNETIC FIELD IN MAGNETOHYDRODYNAMIC INDUCTION MACHINES AND PHYSICAL MODELS RELATING TO THEM. Vol'dek, A. I. Tr. Tallin. Politekh. Inst., Ser. A; No. 266, 3-14(1968). (In Russian).

A critical analysis is presented of articles published by different authors in scientific and technical journals and collected works of the USSR on the analytic solution of problems of the electromagnetic processes in the active zone of the inductive magnetohydrodynamic machines. Analyses are continuing on physical models, real physical conditions, characteristics, and a number of errors which arise in these solutions. (M.H.R.)

51477 GENERATOR OF ELECTRICITY FROM WAVES OF GASEOUS PLASMA, PREFERABLY PRODUCED BY LASER BEAM INITIATED NUCLEAR FUSION REACTIONS. Pedrick, Arthur Paul. British Patent 1,207,698. 7 Oct 1970. Filed 27 Oct 1969.

The system described comprises a furnace for the production of gaseous plasma in the form of a spherical pressure shell, together with means for supporting at the center of the shell a ball of material to be fused into plasma, the supporting means comprising a stream of inert gas entering the base of the shell; a control circuit is operative only when the ball is at the center of the shell. The control circuit pulses a number of laser devices, the beams of which are concentrated on the ball of material. The plasma produced flows out of the furnace up a cylindrical tube, with its flow cross section cyclically modulated by a modulated constricting electromagnetic field applied as a consequence of an ac current applied to the coils of an electromagnet. The modulated plasma flow produces an ac current in an output coil, which is passed to a transformer which, in addition to producing an ac output, provides an ac feedback to the first coil for modulating the outflow of plasma from the furnace. The ball of material may comprise one or more spherical concentric rings of convex lenses, that further concentrate the laser beams upon a central ball containing D, or D and T, under high compression. The arrangement for concentrating the laser beams may also comprise a bullet fired along a tube, the movement of the bullet closing an electrical circuit which energizes the laser devices to feed pulses of laser beams into the tube ahead of the bullet, such pulses reflecting off an internally mirrored diaphragm at the end of the tube back to a mirror surface on the advancing bullet, then back on to the diaphragm and back on to the bullet, and so on until as the bullet approaches the diaphragm the beam pulses are compressed into so small a volume that the diaphragm burns through and the concentrated energy is passed to a convex lens that further concentrates it onto the target ball, or the mass of radiant energy may be directed on as a "ball of fire" moving at about 186,000 miles/sec. (auth)

Fluid Physics

Refer also to abstract 51695.

51478 (N-70-24446) FUNDAMENTAL STUDY OF THE CURRENT DENSITY DISTRIBUTION IN A FLOWING NONEQUILIBRIUM PLASMA. Kim, Chong S. (Toronto Univ. (Ontario). Inst. for Aerospace Studies). Sep 1969. 78p. (NASA-CR-109401; UTIAS-TN-143). NTIS.

In order to determine the current distributions in MHD channels in nonuniform plasma flow, the electric conductivity and the Hall parameter are formulated in the form of the second approximation. A successive iteration procedure is chosen, by which the electron temperature calculated during successive iterations provides the new spatial distribution of plasma parameters at this step of the iteration. The numerical solutions to the current and electron-temperature distributions for uniform conductivity and Hall parameter <1 show diagonally symmetric patterns in a Faraday-type channel. This result can be used as a first iteration for the solution of nonuniform plasma. (auth) (STAR)

51479 (N-70-25712) MAGNETOHYDRODYNAMIC ROTATION IN AN ANNULUS. Hanson, John P.; Cohen, Ira M. (Pennsylvania Univ., Philadelphia. Towne School of Civil and Mechanical Engineering). Jan 1970. 48p. (NASA-CR-109619; INDEC-80). NTIS.

The problem of a liquid conductor confined between two concentric, perfectly conducting, cylindrical electrodes is considered. The liquid metal is electromagnetically accelerated by the Lorentz force in the circumferential direction created when a current is passed between two electrodes and an axial magnetic induction field is maintained. Asymptotic expansions are made in the smallness of the ratio of the magnetic Prandtl number and the smallness of the ratio of the magnetic induction created by the current to that imposed by the magnet. Both parameters are small in a typical laboratory situation. In this limiting situation, nine asymptotically distinct regions are found: an inviscid main region in which the body force is balanced by convective acceleration, and viscous boundary layers on the inner and outer electrode surfaces, the top and bottom insulator surfaces, and four corner regions. It is shown that, for the principal balance of effects over most of the domain, viscosity is unimportant but secondary flows are crucial. (auth) (STAR)

51480 EXPERIMENTAL INVESTIGATION OF CURRENT DENSITY DISTRIBUTIONS IN AN ARGON-POTASSIUM PLASMA STREAMING THROUGH A CHANNEL WITH SEGMENTED ELEC-

TRODES. Dodel, G. (Inst. fuer Plasmaphysik, Munich). Plasma Phys.; 12: 273-92(Apr 1970).

Electron temperature distributions were measured in an argon–potassium plasma streaming through a channel with a segmented-electrode array (similar to that of a Faraday-type MHD generator) to provide information about the relevant current distributions. (auth) (UK)

51481 MHD FLUCTUATING FLOW OF A VISCOUS CONDUCTING FLUID OVER A POROUS FLAT PLATE WITH TIME-DEPENDENT SUCTION. Singh, G. S. (Lucknow Univ., India). Indian J. Pure Appl. Math.; 1: 37-44(Jan 1970).

The flow of a viscous conducting fluid over a porous infinite flat plate under a transverse magnetic field was studied. The suction has been taken as a periodic function of time. The expression for transient velocity profiles has been found out. It is seen from the curves for velocity and skin friction drawn for different values of M that the velocity and skin friction increase with M while they decrease with the parameters ϵ and δ. The mean wall temperature and heat flux are observed to be independent of the frequencies. (auth)

51482 UNSTEADY HYDROMAGNETIC CHANNEL FLOW. Khan, Mohd. Abdul Aleem (Lucknow Univ., India). Indian J. Pure Appl. Math.; 1: 77-86(Jan 1970).

The flow of a viscous, electrically conducting, incompressible liquid between two semi-infinite solids with a transverse magnetic field is analyzed for cases when (i) the semi-infinite solids of arbitrary conductivities with imposed oscillatory current-sheets are harmonically oscillating, and (ii) the oscillating solids are perfectly conducting and there are only induced current sheets on their surfaces. (auth)

51483 RAYLEIGH–TAYLOR INSTABILITY OF AN INVISCID, INFINITELY CONDUCTING FLUID IN THE PRESENCE OF A VERTICAL MAGNETIC FIELD WITH HALL CURRENTS. Ariel, P. D. (Malaviya Regional Engineering Coll., Jaipur, India). Aust. J. Phys.; 23: 595-9(Aug 1970).

The Rayleigh–Taylor instability of an incompressible, inviscid, infinitely conducting fluid of variable density in the presence of a vertical magnetic field was investigated taking account of Hall currents. An explicit solution for the fluid of finite depth and having exponentially varying density was obtained by making use of a variational principle which is shown to characterize the problem. It was found that the stable stratification remains stable in the presence of Hall currents but that there exists a wave number band for which Hall currents destabilize the statically unstable stratification which is stable in their absence. (auth) (Australia)

51484 UNIVERSAL STABILITY OF HYDROMAGNETIC FLOWS. Carmi, S.; Lalas, D. P. (Wayne State Univ., Detroit). J. Fluid Mech.; 43: 711-19(1970).

The nonlinear stability of hydromagnetic flows is investigated by applying energy methods. A universal stability estimate, namely a stability limit for motions subject to arbitrary nonlinear disturbances, is obtained for bounded or periodic domains. The analysis is restricted to fluids possessing constant density and electrical conductivity and temperature or Hall effects are not taken into account. This result establishes the existence of an open region of certain stability near the origin of the $(\tilde{R}_e, \tilde{R}_m)$ Cartesian plane for every fixed P_m (where $\tilde{R}_e$, $\tilde{R}_m$ and P_m are the Reynolds number, magnetic Reynolds number, and magnetic Prandtl number, respectively). The universal stability limit can then be improved by suitably defining a maximum problem using variational techniques, and obtaining the relevant Euler–Lagrange equations. The tentative solution to this problem gives a stability limit which enlarges the universal stability region. The results are then compared with linear and experimental ones, with special emphasis given to the role played by the magnetic field. (auth) (UK)

51485 KINEMATIC PROPERTIES OF HYDROMAGNETIC FLUID FLOWS. Purushotham, G. (Nagarjunasagar Engineering Coll., Hyderabad, India); Rao, P. Sambasiva. Indian J. Pure Appl. Phys.; 6: 382-4(1968).

By assigning unidirection to the magnetic field and using geometrical configuration of spatial curves of congruences formed by the streamlines, principal normals and their binormals, various kinetic and kinematic properties of hydromagnetic flows are established. Kinematic aspects of Bernoulli surface are examined. (auth)

51486 HEAT TRANSFER IN CROSSED-FIELD MHD COUETTE FLOW. Soundalgekar, V. M. (Indian Inst. of Tech., Bombay). Indian J. Pure Appl. Phys.; 6: 326-7(1968).

A study of heat transfer in crossed-fields MHD Couette flow for an incompressible fluid is presented. The wall temperature is assumed to vary linearly in the direction of flow. Closed-form solutions for temperature θ, Nusselt number Nu, and mean mixed temperature T_{1m} are derived. The effects of M (the Hartmann number), K (the electric field parameter), P_rRS (a product of Prandtl number, Reynolds number, and a nondimensional number) on θ, Nu and T_{1m} are presented. It is observed that the symmetrical form of the temperature profiles is distorted by the application of the electric field. Nu decreases with an increase in K, for all values of M, but an increase in mean mixed temperature T_{1m}. (auth)

51487 NOTE ON THE LINEAR FLOW OF A VISCOUS INCOMPRESSIBLE CONDUCTING FLUID PAST AN INFINITE FLAT PLATE WITH CONSTANT SUCTION IN THE PRESENCE OF A TRANSVERSE MAGNETIC FIELD. Dube, S. N. (Banaras Hindu Univ., India). Indian J. Phys.; 43: 550-4(Sep 1969).

Analytical solution was obtained for the momentum equations of the linear flow of a viscous incompressible electrically conducting fluid past an infinite porous flat plate in the presence of a transverse magnetic field when the suction velocity normal to the plate is constant. It is observed that the velocity in the boundary layer increases with the increase of the intensity of the magnetic field. (auth)

Geophysics (Upper Atmosphere)

Refer also to abstracts 51334, 51467, and 51469.

51488 (AD-706073) RESEARCH ON HIGH-ALTITUDE PLASMA PHYSICS. Quarterly Technical Report, January 1–March 31, 1970. Rostoker, N.; Auer, P. L.; Wharton, C. B.; Fleischmann, H. H.; Nation, J. A. (Cornell Univ., Ithaca, N. Y.). 31 Mar 1970. Contract N00014-67-A-0077-0002. 9p. NTIS.

Topics covered include: propagation in a pre-ionized medium; microwave radiation characteristics of a relativistic electron beam; energy transfer in neutral gases in the presence of an axial magnetic guide field; propagation of relativistic electron beams in a toroidal configuration; plasma wind tunnel experiment; collisionless turbulence in plasma; and atomic collision experiment. (USGRDR)

51489 (AD-706410) SHORT-TERM PREDICTIONS ON THE COURSE OF POLAR CAP ABSORPTION. Final Report (Part 1), April 1, 1968–May 31, 1969. Owren, Leif (Dartmouth Coll., Hanover, N. H. Thayer School of Engineering). Dec 1969. Contract F19628-68-C-0308. 127p. (AFCRL-69-541(I)). NTIS.

The physical and empirical facts of polar cap absorption (PCA) produced by solar proton events are reviewed. A description of PCA, its measurement, and the solar–terrestrial environment is included. The physical conditions of the lower ionosphere during PCA are discussed together with the frequency law of PCA, nighttime recoveries, the polar cap distribution of absorption, and arctic hf propagation during PCA. A procedure for short-term prediction of the future course of PCA is developed, based on single-frequency riometer measurements and computer processing of the data. The application of the prediction technique is illustrated by a detailed discussion of two PCA events. It is concluded that, for most PCA events, satisfactory short-term predictions can be made from riometer observations. (USGRDR)

51490 (AD-706863) INCOHERENT SCATTER MEASUREMENTS OF F-REGION DENSITY, TEMPERATURES, AND VERTICAL VELOCITY AT MILLSTONE HILL. Evans, John V.; Julian, Ralph F.; Reid, Wallace A. (Massachusetts Inst. of Tech., Lexington, Lincoln Lab.). 6 Feb 1970. Contract AF19(628)-5167. 43p. (TR-477; ESD-TR-70-98). NTIS.

The Millstone Hill Thomson (incoherent) scatter radar system has been operated routinely since 1963 to perform a synoptic study of F-region electron densities and electron and ion temperatures. This report describes system changes made in 1968, which considerably increased the accuracy of the measurements and allowed their extension to higher altitudes. These changes have also made it possible to measure the vertical velocity of the plasma over the altitude range 450 to 900 km to an accuracy on the order of 5 to 10 m/sec, depending upon altitude and time of day. Of even greater significance, complete machine reduction of the results is now possible so that considerable savings in time and effort have been secured in analyzing the data. The new system permits all the radar data to be gathered in the digital computer in real time, thereby eliminating the need for post real-time processing of magnetic-tape recordings of the signals. Furthermore, it is now possible to transmit the data to other workers in computer-usable form. This report describes the main functions of the computer

program required to analyze the measurements, and lists the times of all measurements made with the new system prior to Jan. 1970. Examples of these results are presented and discussed. (auth) (USGRDR)

51491 (AD-706873) RESEARCH ON EXTREMELY LOW FREQUENCY PROPAGATION WITH PARTICULAR EMPHASIS ON SCHUMANN RESONANCE AND RELATED PHENOMENA. PART II. LOCATION OF SOURCES. Final Repoooort, January 15, 1965–November 15, 1969. Toomey, John; Polk, Charles (Rhode Island Univ., Kingston. Dept. of Electrical Engineering). 1 Apr 1970. Contract AF19(628)-4950. 172p. (AFCRL-70-226). NTIS.

Experimental techniques for the measurement of natural extremely low frequency (elf) electromagnetic noise are described, including methods for absolute calibration of magnetic and electric field sensors in this frequency range (3 to 30 Hz). After a review of the theory applicable to earth–ionosphere cavity resonances, a method is developed that permits location of two simultaneously active, major thunderstorm regions on the surface of the Earth by analysis of elf spectra. In particular, use is made of electric to magnetic field ratios and of ratios involving the power spectrum magnitudes at adjacent resonant peaks. Limitations of the method are analyzed, particularly those related to frequency alpha background noise and to quasi-uniformly distributed minor lightning activity which adds to the noise originating in the major thunderstorm regions. Appropriate methods of spectral analysis—appropriate frequency resolutions and integration times—are determined and the method is illustrated by experimental data. It is also indicated how the source location procedure—in conjunction with exact data (plus or minus 0.25 Hz) describing the position of the resonant peaks—may be used to evaluate ionospheric conductivity profiles extending downward to about 40 km. (auth) (USGRDR)

51492 (AD-706904) RADAR INVESTIGATIONS OF AURORAL INFRASONIC WAVE SOURCES. Annual Report, February 27, 1969–February 28, 1970. Fremouw, Edward J. (Stanford Research Inst., Menlo Park, Calif.). Apr 1970. Contract F44620-69-C-0074. 76p. (AFOSR-70-1431-TR). NTIS.

A radar investigation of possible sources of auroral infrasonic waves (AIW) has disclosed evidence of a relation between AIW sources and radar aurora in supersonic motion. The study employed pre-existing and specially obtained data from the DASA-SRI auroral radar located near Homer, Alaska. Data from the Homer radar were compared with AIW data obtained during five equinoctial periods at the infrasonics observatory operated by the Geophysical Institute of the University of Alaska at College, Alaska. (auth) (USGRDR)

51493 (AD-707131) IONOSPHERIC RESEARCH USING SATELITES. Final Scientific Report, November 17, 1965–October 6, 1969. Hunter, A. N.; Kelleher, R. F. (University Coll., Nairobi (Kenya). Dept. of Physics). Nov 1969. Contract AF61(052)-909. 46p. (AFCRL-70-289). NTIS.

Results obtained from total electron content measurements, scintillation observations and spaced aerial irregularity studies in East Africa are summarized. The development and movement of the equatorial anomaly in total electron content throughout the day is examined for different seasons and the effects found to be most pronounced in the equinoxes. Some control by magnetic activity is indicated. A number of problems in the data reduction is discussed. Variations in the extent of the F-region equatorial irregularity belt with season and local time were found. Irregularities were detected (by dispersion analysis) at heights from 85 to 800 km, the average size (20 to 400 m) being almost constant at all altitudes. The maximum occurrence is found at or near hmF2 and at E, heights. The movement of irregularity patches is predominantly towards the east before 0600 L.M.T., and to the west after this time. Considerable polarization scintillation is found at 20 MHz. (auth) (USGRDR)

51494 (AD-707139) ELECTRON CONTENT AND SMALL SCALE IRREGULARITIES IN THE POLAR IONOSPHERE. Scientific Report (Final), November 1, 1966–October 31, 1969. Bratteng, Ove M.; Frihagen, Jon (Auroral Observatory, Tromso (Norway)). 20 Dec 1969. Contract F61052-67-C-0020. 60p. (AFCRL-70-286). NTIS.

Some results of high-latitude measurements of electron content and scintillation by means of satellite beacons are presented and discussed. Studies previously reported were extended and amplified. Some features of the diurnal variation of the polar cap electron content can be explained by quite reasonable models. The polar enhancement of electron content mapped in geomagnetic coordinates coincides with a corresponding maximum in vlf noise. The electron content dependency on the mean sunspot activity has a marked semi-annual variation with a maximum at the equinoxes. Pc5 micropulsations seem to enhance the morning growth of the F layer. Geomagnetic storms very often induce large variations in electron content. There is a trend for a positive phase during the first hours after sudden commencement followed by a rather large negative phase exhibiting a maximum after about 24 hours. The high-latitude F-retion irregularities are separated in the "auroral" and "polar" maxima. There is a very strong Kp dependence even for the lowest Kp indices. (auth) (USGRDR)

51495 (AD-707405) OBSERVATIONS OF PROTON BURSTS IN THE MAGNETOTAIL WITH EXPLORER 35. Fennell, Joseph F. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Jun 1970. Contract N00014-68-A-0196-0003. 41p. NTIS.

Energetic proton bursts (proton energy greater than or equal to 32 MeV) are observed at 60 R_E in the magnetotail by Explorer 35. The intensity is usually anisotropic. The net proton flow as measured in the ecliptic plane is found to be most often, but not always, nearly parallel or antiparallel to the local magnetic field, and is sometimes toward and sometimes away from the Earth. The protons are usually observed during high-latitude magnetic bay activity at the Earth. Companion observations outside the bow shock by Explorer 33 show that the proton bursts are not of solar origin. One observation evidences possible proton flow away from the Earth, across the neutral sheet, and back toward the Earth parallel to the field in the ecliptic plane. The proton bursts have spectral e-folding energies of 50 to 110 keV and peak intensities of 14 to 420/(sq.cm sec ster), values that are similar to those for protons near the outer-zone trapping boundary. (auth) (USGRDR)

51496 (AD-707501) MILLSTONE HILL THOMSON SCATTER RESULTS FOR 1965. Evans, John V. (Massachusetts Inst. of Tech., Lexington. Lincoln Lab.). 8 Dec 1969. Contract AF19(628)-5167. 58p. (TR-474; ESD-TR-69-387). NTIS.

F-region electron densities and electron and ion temperatures observed during the year 1965 at the Millstone Hill Radar Observatory by the uhf Thomson (incoherent) scatter radar are presented. The measurements were made over 48-hour periods that were usually scheduled to include the International Geophysical World days near the center of each month. Geomagnetic storm sudden commencements occurred during two of the observing periods, but do not appear to have given rise to marked variation of the densities or temperatures. On the other hand, measurements made during the progress of a major storm (June 15–19, 1965) exhibit large changes compared with the behavior observed in the following month. The remaining months were magnetically quiet and the density and temperature behavior were similar to those observed in 1964. Millstone is a midlatitude station exhibiting a characteristic "winter" and "summer" daytime density variation. The transition between these two types occurs rapidly around equinox without any corresponding seasonal change in the F-region thermal structure. Current ideas concerning the mechanisms responsible for this and other features of diurnal and seasonal variations are discussed. (auth) (USGRDR)

51497 (AD-707764) EXPERIMENTAL STUDY OF VLF MODE COUPLING AND POLARIZATION REVERSAL. Progress Report. Rodriguez, Paul; Gurnett, Donald A. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Mar 1970. Contracts N00014-68-A-0196-0003; NAS5-10625. 39p. NTIS.

Below the proton gyrofrequency, both polarization reversal and mode coupling of the right and left hand modes of propagation can occur. An experimental study of polarization reversal and mode coupling of electron and proton whistlers is presented. The occurrence of polarization reversal for a whistler signal observed in the ionosphere is indicated by the presence of a proton whistler. Mode coupling between the right and left hand modes of propagation is indicated by the occurrence of both electron and proton whistler signals at the same frequency. Mode coupling is observed to occur most frequently over a range of about 35 to 55° magnetic latitude. Below about 35° magnetic latitude, polarization reversal is the predominant effect, whereas above about 55° magnetic latitude neither mode coupling nor polarization reversal occur and proton whistlers are not observed. These results are compared with existing theories to explain this latitude dependence. (auth) (USGRDR)

51498 (AD-707822) MAGNETIC CONTROL OF GLOBAL PATTERNS OF F-LAYER VERTICAL DRIFT CAUSED BY NEUTRAL WINDS. Environmental Research Papers. Pike, C. P. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). May 1970. 14p. (AFCRL-70-275; AFCRL-ERP-321). NTIS.

Basic considerations to a study of F-layer modification by vertical drift from any postulated neutral atmospheric wind system are the effects of local magnetic inclination and declination upon the resulting F-layer vertical drift velocity. The effect of local magnetic inclination enters in the term sin I cos I contained in the expression for the vertical drift velocity $V_z \pm V \sin I \cos I$, where V is the wind velocity in the horizontal plane. A global

map with contours of sin I cos I is presented which enables one to compare the effect of inclination in different regions. This map shows where inclination would either tend to null or to maximize F-layer vertical drift respectively. The global maps clearly show that vertical drift is often strongly nonsymmetric at magnetic conjugate locations. Finally, an understanding of F-layer structure and dynamics is particularly important in many radio propagation problems. (auth) (USGRDR)

51499 (N-70-24251) OBSERVATIONS FROM OGO-5 OF THE THERMAL ION DENSITY AND TEMPERATURE WITHIN THE MAGNETOSPHERE. Serbu, G. P.; Maier, E. J. R. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Jan 1970. 39p. (NASA-TM-X-63871; X-615-70-34). NTIS.

The OGO-5 retarding potential analyzer experiment is operated in a voltage mode designed to yield the integral spectrum of both ions and electrons in the energy interval from 0 to 500 eV. Detailed results obtained with the spacecraft inside 7 R_E during the first 15 orbits (March-April 1968) are presented. Identification and grouping of the data into three types of density profile is presented. First, a smooth decrease occurs in ion density. A second general type of observed density profile is typified by considerable structure within the plasmasphere and the plasmapause and identified by a factor of 3 or more drop in ion density. The third type of profile shows a density drop of a factor of 20 or more inside the $L = 7\ R_E$ radial distance to values below the minimal detectable level. (auth) (STAR)

51500 (N-70-24381) ONE-DIMENSIONAL TIME-DEPENDENT INTERACTION OF A SATELLITE WITH THE IONOSPHERIC PLASMA. Stone, Nobie H.; Sheldon, John W. (National Aeronautics and Space Administration, Huntsville, Ala. George C. Marshall Space Flight Center). Apr 1970. 46p. (NASA-TR-R-335; M-431). NTIS.

A theoretical study and numerical solution are presented for the one-dimensional, time-dependent problem of a streaming, nonuniform, fully ionized, collisionless plasma impinging upon a stationary, flat conducting plate oriented perpendicularly to the flow of the plasma. The problem is intended to model the interaction of the frontal surface of a satellite with the ionospheric plasma. The time-dependent equations that describe the one-dimensional problem are established, and from them the steady-state equations are derived. These steady-state equations are solved for the spatial dependence of the electric field, which is seen to be a reasonable form and to agree with previous work on more complicated configurations. Finally, a numerical method of solving the time-dependent equations is presented and applied to two special cases: (1) for a plate that has no initial charge, and (2) for a system that is initially in an equilibrium state and proceeds to a second equilibrium state because of a step transition in the plasma parameters. (auth) (STAR)

51501 (N-70-24824) EXPERIMENTAL STUDY OF THE ION CHEMISTRY AND THERMAL BALANCE IN THE E AND F REGION ABOVE WALLOPS ISLAND. Pharo III, M. W.; Scott, L. R.; Mayr, H. G.; Brace, L. H.; Taylor, H. A. Jr. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Dec 1969. 28p. (NASA-TM-X-63877; X-621-69-551). NTIS.

Measurements by a Bennett ion mass spectrometer and two electrostatic probes aboard NASA rocket flight 18.06 on August 26, 1966, produced altitude profiles of ion composition and concentration and electron concentration and temperature in the E and F regions above Wallops Island, Virginia. These charged-particle measurements, supported by the measurements of N_2 concentration and neutral gas temperature (measured twenty minutes earlier by experiments on NASA 18.05), measurements of the extreme-ultraviolet spectrum, and the 1964 Jacchia model (for the remaining neutral constituents) serve as a basis for determining reaction rates of the primary chemical reactions responsible for the formation of the ionosphere. Electron temperature measurements and N_2 temperatures and concentrations provided rates for electron and ion cooling. The primary thermospheric processes with their reaction rates are shown. The values are comparatively low, but within a factor of three of the values derived in laboratory experiments. The derived cooling rates throughout the entire altitude range were similar to those derived from measurements above Wallops Island in 1960 and 1961 at similar levels of solar activity. (auth) (STAR)

51502 (N-70-25555) SOLAR-WIND DEPENDENCE OF THE DIURNAL TEMPERATURE VARIATION IN THE THERMOSPHERE. Jacchia, Luigi G. (Smithsonian Astrophysical Observatory, Cambridge, Mass.). 27 Mar 1970. 14p. (NASA-CR-109523; SAO-311). NTIS.

The ratio of the maximum to the minimum exospheric temperature considered on a global scale was derived by means of static models using the densities obtained from the atmospheric drag of three low-inclination satellites. It was found that r varies with the solar cycle, lagging more than a year behind the variations of the 10.7-cm solar flux; on the other hand, the variations of r were in phase with the mean value obtained by averaging the planetary geomagnetic index over the whole year. The obvious conclusion is that in the mechanism of the diurnal temperature variation in the thermosphere, the solar wind is at least as important as, if not more important than, solar euv. No appreciable lag was found in the variation of the minimum nighttime temperature when compared with the variations of the 10.7-cm solar flux. (auth) (STAR)

51503 (N-70-26182) EXPANSION OF AN ION CLOUD IN THE EARTH'S MAGNETIC FIELD. Pilipp, W. (Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany)). Translation of report MPI-PAE/EXTRATERR-28. 190p. (NASA-TT-F-12745). NTIS.

The expansion of an ion cloud in a homogeneous magnetic field is examined with reference to the Heos cloud experiment. Section 1 describes the formation of the barium ion cloud and its expansion in the Earth's magnetic field. Section 2 contains the numerical computations. In Section 3 the upper limit of the maximum radius of the cloud is estimated from the energy balance for the expansion of several cloud models. Section 4 discusses the formation of flute instability as a result of the lag in expansion perpendicular to the magnetic field. Section 5 describes the cloud models in detail as well as the corresponding basic equations. (auth) (STAR)

51504 (N-70-27302) DISCREPANCIES IN THE OBSERVED PLASMA-TROUGH DENSITY. Maier, E. J. R.; Serbu, G. P. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Mar 1970. 14p. (NASA-TM-X-63905; X-621-70-77). NTIS.

Observations of the plasmapause have now been achieved by a variety of techniques: ground based reception of whistlers, in-situ observations by mass spectrometers, retarding analyzers, and vlf receivers. Comparisons of some of these observations are made, and it is concluded that the details of the plasmasphere boundary and the thermal plasma density beyond the plasmasphere are more variable than the idealized plasmasphere model would suggest. (auth) (STAR)

51505 (N-70-27356) MAGNETOSPHERIC PLASMAPAUSE AND THE ELECTRON DENSITY TROUGH AT THE ALOUETTE 1 ORBIT. Rycroft, M. J.; Thomas, J. C. (Imperial Coll. of Science and Technology, London (England). Dept. of Physics). Apr 1968. 43p. (NASA-CR-109765). NTIS.

The location of the magnetospheric plasmapause or "knee" and the position of the electron density minimum or "trough" at the orbit of the Alouette 1 satellite near 1000 km were derived from whistler data and from topside ionograms respectively. A statistical study of the dependence of both knee and trough positions on the degree of magnetic disturbance and on local time during the summer of 1963 reveals that, in general, within the statistical scatter, the geomagnetic field lines on which each occur are the same. It is inferred that the plasmapause in the magnetosphere and the trough near the exospheric base are related phenomena, and that a sharp decrease of plasma density occurs beyond a particular field line, the position of which depends on local time and on the degree of geomagnetic activity. For magnetically quiet conditions (kp = 0), this line of force corresponds to L ~ 5.6 near midnight, whereas for moderate magnetic activity (kp = 3) its L value is ~4. The radial distance at which this field line crosses the equatorial plane decreases at a rate of ~0.1 Earth radii/hour throughout the local night. The geomagnetic latitude at which the field line concerned reaches an altitude of 1000 km is ~57° at 02.00 LT for Kp ~3, and decreases at a rate of 1.8 + 0.4° per unit increase of Kp. (auth) (STAR)

51506 (N-70-27428) MAGNETIC FIELD AND ELECTRON OBSERVATIONS NEAR THE MAGNETOPAUSE. Ogilvie, K. W.; Scudder, J. D.; Sugiura, M. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Apr 1970. 28p. (NASA-TM-X-63900; X-392-70-159). NTIS.

Observations of electron fluxes at energies between 25 and 130 eV by the triaxial electron spectrometer on OGO-E, and of the magnetic field by the magnetometer on the same satellite, were used to study the magnetopause at quiet and at fairly disturbed times. They indicated that the boundary, whose thickness of order 100 km is sometimes resolved, is either at rest or moving with a speed of order several km/sec with an amplitude of 1 to 2 R_E. Pressure balance indicated that β in the magnetosphere close to the boundary is frequently of order unity. This, in turn, indicated the presence of plasma adjacent to the mag-

netopause on the dawn side, in agreement with other observers. (auth) (STAR)

51507 (N-70-29987) AURORAL ELECTRON DRIFT AND PRECIPITATION: CAUSE OF THE MANTLE AURORA. Hoffman, R. A. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Jun 1970. 42p. (NASA-TM-X-63941; X-646-70-205). NTIS.

Data from the auroral particles experiment on OGO-D were analyzed to determine the properties of the band region of low-energy electron precipitation in the late morning hours. The existence of this precipitation is consistent with a scheme involving a release of a body of electrons on closed magnetic field lines in the vicinity of midnight at the time of a magnetospheric substorm, with a subsequent drift in local time through the morning hours at least as far as noon. While drifting, the electrons encounter a strong pitch-angle diffusion mechanism that precipitates them into the atmosphere to produce the mantle aurora. This mechanism seems to exist independent of substorm magnetic activity. The diffusion coefficient must be larger than 0.001/sec, and the resulting lifetime of the electrons is about 6,000 sec. The energy density of the source electrons in the midnight region would not be unreasonably large if the source is in the cusp. (auth) (STAR)

51508 (N-70-30120) LOW-FREQUENCY INTERCHANGE INSTABILITIES OF THE RING CURRENT BELT. Liu, C. S. (California Univ., Los Angeles. Plasma Physics Group). Jan 1969. Contract Nonr-4756(01). 60p. (NASA-CR-103292). NTIS.

The stability of the ring current belt against low-frequency, electrostatic perturbations is analyzed, with the effect of a finite electric field along the magnetic line of force included. Four possible instabilities are found: the hydromagnetic interchange, the trapping instability, the low-frequency flute mode, and the resonant interchange; the conditions for their occurrence in the ring current belt are derived. Due to the parallel electric field associated with the instabilities, their main consequence is to precipitate charged particles into the ionosphere, leading to ring current pressure relaxation. Their possible relevance to observations is discussed. (auth) (STAR)

51509 DIFFUSION OF METEOR TRAINS. Pickering, W. M.; Windle, D. W. (Univ. of Sheffield, Eng.). Planet. Space Sci.; 18: 1153-61(Aug 1970).

The mathematical formulation and method of solution of the problem of the diffusion of cylindrical plasma inhomogeneities, such as meteor trains, in the presence of a magnetic field are discussed. The results obtained are described only briefly since they have already been discussed in detail in Kaiser, Pickering and Watkins (1969). The results indicate that the behavior of such a meteor train is strongly dependent upon the angle, θ, between the train axis and geomagnetic field direction. For an altitude of 102 km, it is found that for $\theta < 1\frac{1}{2}°$ approximately, the transverse diffusion is electron-controlled and hence considerably inhibited by the geomagnetic field, whereas for $\theta > 1\frac{1}{2}°$ the transverse diffusion is found to be ion-controlled and little influenced by the presence of the magnetic field. (auth) (UK)

51510 ANOMALOUS NIGHTTIME INCREASES IN TOTAL ELECTRON CONTENT. Young, D. M. L.; Yuen, P. C.; Roelofs, T. H. (Univ. of Hawaii, Honolulu). Planet. Space Sci.; 18: 1163-79(Aug 1970).

A study of anomalous nighttime increases in total electron content at Hawaii from September 1964 to September 1968 shows that the typical increase lasts from 2 to 4 hr, has a mean size of 6×10^{16} electrons/m^2, and peaks during 2100 to 2200 HST and 0100 to 0200 HST. Its amplitude depends upon the preceding peak daytime content and the concurrent background content. The increases exhibit both seasonal and solar cycle dependences, but no correlation was found with magnetic activity. A source of ionization which is external to the column of content observed and which may be different from that which maintains the nighttime ionosphere is required to explain the data. Two possible sources are conjugate point exchange of ionization and ionization movements due to electrodynamic drifts. The ionization source has a westward velocity component. Its effects occasionally are highly localized since data at four locations spaced a few hundred kilometers apart exhibit different patterns. A pre-sunrise dip in content can be interpreted as the content returning to its former nighttime decay rate after the occurrence of an anomalous increase near sunrise. (auth) (UK)

51511 STUDY OF THE THERMAL PLASMA ON CLOSED FIELD LINES OUTSIDE THE PLASMASPHERE. Mayr, H. G.; Grebowsky, J. M.; Taylor, H. A. Jr. (Goddard Space Flight Center, Greenbelt, Md.). Planet. Space Sci.; 18: 1123-35(Aug 1970).

OGO 4 ion composition measurements near the midlatitude light-ion trough below 1000 km are used for a model for the plasma state along the magnetic field lines that produces, in the equatorial plane, the sharp density gradient characteristic of the plasmapause. In this model the field-aligned plasmasphere boundary is a boundary across which the characteristics of the proton flux along the field lines change. Within the plasmasphere the proton fluxes along the field lines are of small or vanishing magnitude and may be directed either away from or towards the Earth. By contrast, the small equatorial ion densities (~1/cc) known to exist on closed field lines outside the plasmasphere are consistent with the measured low-altitude densities only if large proton fluxes, of the order of the critical flux, are directed along the field lines. These latter fluxes are directed away from the Earth and correspond to the attainment of supersonic proton flow velocities on closed field lines outside the plasmasphere. This is consistent with the model of a supersonic polar wind convecting onto closed field lines. (auth) (UK)

51512 ENERGY DEPENDENCE OF THE EQUATORIAL PITCH ANGLE DISTRIBUTION OF TRAPPED PROTONS. Watari, Nobuo; Kamiyama, Hiroshi (Tohoku Univ., Sendai). Rep. Ionosphere Space Res. Jap.; 24: 127-34(Jun 1970).

The energy dependence of the equatorial pitch-angle distribution for protons trapped in the radiation belt is discussed on the basis of the adiabatic theory. When an exponential form is assumed for the energy spectrum at the source, even if the e-folding energy is constant regardless of the pitch angle, a conclusion is reached from the theory that the inward transport of particles due to the violation of the third adiabatic invariant results in the energy dependence of the equatorial pitch-angle distribution. From the comparison of the theoretical results with the observations, a suggestion is made that the equatorial pitch-angle distribution at the source is approximated by $\sin^{1.5}\alpha$. When the source energy spectrum is assumed to be given by a power-law form, the pitch-angle distribution is shown to be independent of the energy. The observational facts indicate that the proton energy spectrum in the outer radiation zone is expressed by an exponential form rather than a power law. (auth)

51513 CORRELATED OCCURRENCE OF ENERGETIC ELECTRON BURSTS IN THE MAGNETOTRAIL AND GEOMAGNETIC IMPULSIVE MICROPULSATION. Murayama, Takashi (Nagoya Univ., Japan). Rep. Ionosphere Space Res. Jap.; 24: 135-46(Jun 1970).

A conspicuous correlation was found between impulsive micropulsations (Pi's) observed on the Earth's surface and energetic electron bursts observed by a detector on the IMP-1 satellite in the magnetotail. Both of the events started at the same time within an error of about one minute. Examination of 52 Pi's led to a conclusion that electron bursts are formed in the tail in association with every onset of the Pi events and the bursts have wide spatial extent in the tail. About 25% of 397 electron bursts observed in the tail were found to be associated with Pi oscillations. Experimental evidence was obtained that suggests that electron bursts associated with Pi's are formed by electrons liberated from the outer edge of the outer zone of the trapped-radiation region. (auth)

51514 SUMMARY OF DAILY OBSERVATIONAL RESULTS OF SOLAR PHENOMENA, COSMIC RAY, GEOMAGNETIC VARIATION, IONOSPHERE, RADIO WAVE PROPAGATION, AND AIRGLOW DURING JUNE 1968 THROUGH SEPTEMBER 1969. Rep. Ionosphere Space Res. Jap.; 24: 163-82(Jun 1970).

Diagrams illustrate the summary of daily observational results of solar phenomena, cosmic rays, geomagnetic variations, the ionosphere, radio-wave propagation, and airglow observed in Japan. The observational results are arranged by the solar rotation number. The aim is to disseminate an outline of daily events observed in Japan for the benefit of active research workers who plan to make detailed study of the specific solar and terrestrial events. Therefore, the illustrations do not show all observational results in Japan but only representative ones at some key stations. (auth)

51515 SUBSTORM ASPECTS OF MAGNETIC PULSATIONS. Gendrin, R. (Groupe de Recherches Ionospheriques, Saint-Maur, France). Space Sci. Rev.; 11: 54-130(Sep 1970).

The different types of magnetic pulsations occurring during magnetospheric substorms are analyzed in terms of the concept of polar substorms recently described in detail by Akasofu (1968). Special attention is thus paid to the simultaneous occurrence of different types of micropulsations at different places around the Earth, during the development of a substorm. Time lags between the appearance of micropulsations and other geophysical effects of the substorm are of fundamental importance in this respect. Relationships between the occurrence or spectral shape of micro-

pulsations and the state of the magnetosphere, as determined by satellite measurements, are also of interest. Recent theoretical studies about the origin of these micropulsations are reviewed: natural hm emissions are directly linked to the thermal plasma density, the high-energy particle fluxes and pitch-angle distributions in the far magnetosphere (L ~ 5 to 8). One can thus expect to deduce some information about the changes of these quantities during substorms. New semi-quantitative work is reported, which tries to interpret the repetitive structure of SIP events in terms of thickness of the magnetospheric tail, and the frequency drift of IPDP's in terms of magnetospheric electric fields. The present knowledge about absorption and dispersion of hydromagnetic waves through the ionosphere or inside the submagneto-ionospheric guide is also stated, since not taking these effects into account could lead to misinterpretation of the data. (auth)

51516 AMPLIFICATION OF HYDROMAGNETIC WAVES THROUGH THE EARTH'S BOW SHOCK. Asseo, E.; Berthomieu, G. (Institut d'Astrophysique, Paris). Planet. Space Sci.; 18: 1143-52(Aug 1970).

The observation of the turbulence in the magnetosheath generated by amplification, through the Earth's bow shock, of the hydromagnetic fluctuation carried by the solar wind is discussed. This problem is closely related to the study of the transmission and generation of hydromagnetic waves through an oblique fast shock wave. An incident wave (Alfvén, magnetosonic, or entropy wave) striking the front of the shock is refracted and gives rise to five other hydromagnetic waves. A system of equations is given to determine the transmission and generation coefficients of these diverging waves. Given a model of the Earth's bow shock, the ratio of refracted to incident energy fluxes is computed. It appears that there is always amplification, at least for one refracted wave, but its value varies greatly with the direction of the incident wave. Therefore, further information about the angular distribution of the hydromagnetic perturbations carried by the solar wind is required to give an order of magnitude of the energy of the turbulence created. (auth) (UK)

51517 MAGNETIC AND ELECTRIC FIELDS IN THE MAGNETOSHEATH. Alksne, Alberta Y.; Webster, David L. (Ames Research Center, Moffett Field, Calif.). Planet. Space Sci.; 18: 1203-12(Aug 1970).

A method is given by which the steady-state magnetic field at any point in the magnetosheath can be calculated for a uniform interplanetary field of any arbitrary direction and magnitude by linear superposition of the field vectors shown on three graphs. Such superposition is made possible by use, for the magnetosheath flow field, of the steady-state, axisymmetric velocity function obtained from gasdynamic calculations. The resulting equations for the field, B, are thus linear and homogeneous in B. Two additional graphs are given from which the electric field E can be obtained by superposition. One further graph contains the information required to calculate the charge density. Algebraic formulas are given that simplify and systematize the use of the graphs. (auth) (UK)

51518 F2-LAYER AT MIDDLE LATITUDES. Strobel, D. F.; McElroy, M. B. (Kitt Peak National Observatory, Tucson, Ariz.). Planet. Space Sci.; 18: 1181-1202(Aug 1970).

A detailed numerical study is made of the physical and chemical processes that determine the structure of the F2 layer at middle latitudes. Results are compared with observations reported by Evans (1967) for Millstone Hill in April 1964. The theoretical model, with measured values of solar flux, absorption cross sections, and chemical rate constants for input data, satisfactorily accounts for the observed diurnal variation of the electron density. Motions of the neutral atmosphere exert important influences on the ionosphere, lowering the height of the F2 peak during the day and raising it at night. The evening increase in the peak electron density is attributed to the rapid decay of electron temperatures at sunset. The decay is accompanied by a collapse in the topside ionosphere, as first suggested by Evans. The downward ionization drift induced by neutral winds decreases in the evening and exerts a modifying influence on the formation of an evening maximum by raising the F2 peak. The theoretical model is applied to a study of the seasonal anomaly. It is suggested that the anomaly results from two distinct mechanisms. The shape of the F2 layer depends on the strength of the neutral winds. These winds are stronger in winter than summer and cause the winter daytime F2 layer to be more compact than the summer daytime F2 layer. The observed increase in the peak electron densities during the winter day can be explained by a seasonal variation in neutral composition, relatively more atomic oxygen in the winter thermosphere. This assumption is supported by recent mass spectrometric data (Krankowsky et al., 1968). A seasonal variation in the vibrational temperature of N_2, higher in the summer and lower in the winter, can also account for the observed daytime seasonal variation in the peak electron density, since the reaction $O^+ + N_2 \rightarrow NO^+ + N$ is very sensitive to the N_2 vibrational temperature. (auth) (UK)

51519 MILLSTONE HILL THOMSON SCATTER RESULTS FOR 1965. Evans, J. V. (Massachusetts Inst. of Tech., Lexington). Planet. Space Sci.; 18: 1225-53(Aug 1970).

F-region electron densities, electron and ion temperatures observed during the year 1965 at the Millstone Hill radar observatory (42.6°N, 71.5°W) by the UHF Thomson (incoherent) scatter radar are presented. The measurements were made over 48-hr periods that were usually scheduled to include the International Geophysical World days near the center of each month. Most measurements were made during magnetically quiet periods, and are thought to be representative of the behavior expected on the rising part of the sunspot cycle. It is shown that Millstone is a midlatitude station exhibiting a characteristic winter and summer daytime density variation, and that the transition between these two types occurs rapidly around equinox without any corresponding seasonal change in the F-region thermal structure. Current ideas concerning the mechanisms responsible for this and other features of diurnal and seasonal variations are discussed. It is proposed that photoelectron escape leading to heat deposition in the protonosphere serves to equalize the plasma temperatures in conjugate ionospheres. As a result there is little seasonal variation in electron or ion temperature and magnetic control of the topside electron densities is established. (auth) (UK)

51520 DENSITY AND VIBRATIONAL DISTRIBUTION OF MOLECULAR OXYGEN IN THE LOWER THERMOSPHERE. Reid, R. H. G. (Smithsonian Astrophysical Observatory, Cambridge, Mass. Harvard Coll. Observatory, Cambridge, Mass.); Withbroe, George L. Planet. Space Sci.; 18: 1255-65(Aug 1970).

Observations of solar uv radiation from the satellite OSO-IV are analyzed. The atmospheric absorption of 1032 Å (O VI) can be reproduced theoretically by a static diffusion model of the O_2 density above 120 km with a density of $(3.6 \pm 0.4) \times 10^{10}$ cm^{-3} at 120 km. The atmospheric absorption of 1335 Å (C II) appears to require an effective absorption cross section of O_2 that decreases with increasing altitude. The decrease could result from an increasing vibrational development of O_2 such that the fraction of molecules in the ground vibrational state is less than about 0.9 at 130 km, 0.7 at 150 km, and 0.5 above 160 km. (auth) (UK)

51521 SECONDARY PRODUCTION PROCESSES FOR THE HYDROXYL ATMOSPHERIC AIRGLOW. Breig, E. L. (Aerospace Corp., El Segundo, Calif.). Planet. Space Sci.; 18: 1271-4(Aug 1970).

Two secondary mechanisms for the OH airglow are examined and discussed in the light of recent experimental and theoretical results. The first part discusses the contribution from vibrationally excited molecular oxygen at high altitudes and the limitations imposed upon this mechanism by the rapid quenching of O_2 (v) by atomic oxygen. The second part examines a process involving HO_2 that could add important contributions to the OH dayglow intensity and assist in explaining some of the related problems. (UK)

51522 CORRELATION STUDIES BETWEEN AURORAL-ZONE X RAYS AND RADIO WAVE ABSORPTION. Kangas, J.; Tanskanen, P. (Univ. of Oulu, Finland). Ann. Acad. Sci. Fenn., Ser. A VI; No. 326, 1-16(1970).

Simultaneous auroral-zone x-ray and CNA (cosmic noise absorption) measurements made in Finland in 1965 and 1966 are analyzed. In general, a close correlation is found between these two phenomena, thus indicating similar variations of electron fluxes in the energy range involved. The southward extension of the precipitation region is shown to be greatly dependent on geomagnetic activity. The K_p index seems to bear relation to the southward extension of high-energy auroral phenomena. Precipitation events are seen to appear at the Sodankylä latitude in 1965 during lower K_p values than in 1966. As to the production of CNA, spectral variations of electron fluxes and detachment processes are shown to be of great importance. The photochemical processes seem to be quite effective in the D region. (auth) (Finland)

51523 MAGNETIC CONJUGACY IN THE F2-REGION OF THE IONOSPHERE. Torr, Marsha R.; Torr, D. G.; Harland, G. (National Inst. for Telecommunications Research, Johannesburg). Planet. Space Sci.; 18: 1275-8(Aug 1970).

It was shown in a previous paper (Torr and Torr, Planet. Space Sci.; Vol. 17, p. 2025, 1969; NSA 24: 17775) that there is a distinct difference between the cross correlation coefficients of deviations of f_0F2 from the monthly median (Δf_0F2) at magnetically conjugate pairs of stations and the coefficients obtained

for pairs of stations not conjugate at all. The analysis is extended and the dependence on magnetic activity is investigated as well as the variation of the coefficients from day to night. It is found that there is little difference between the correlation coefficients obtained for the day or night or whole 24-hour period, but there is a tendency for correlation during the day to be slightly larger. Conjugacy during magnetically disturbed conditions is generally found to be larger than during average conditions. During magnetically quiet periods, conjugacy is found to be practically nonexistent. (UK)

51524 CHANGES IN IONOSPHERE PARAMETERS DURING PARTIAL SOLAR ECLIPSE OVER BEKESHCHABA, MAY 20, 1966. Florian, E. (Geophysical Inst., Budapest). Ann. Univ. Sci. Budapest. Rolando Eotvos Nominatae, Sect. Geol.; 12: 49-56(1968). (In Russian).

Changes in ionosphere parameters arose largely during the second half of the eclipse. The decrease in critical frequencies for the F1 and F2 layers was twice the decrease for the E layer. The drop in electron concentration was twice as much for F1 and three times as much for F2 as for E. The recombination coefficient varied from 1.5 to 2.5×10^{-7} cm^3 sec^{-1}. A slope in the F1 layer could be demonstrated. (tr-auth)

51525 ELECTRON COLLISION FREQUENCY, IONOSPHERIC G FACTOR, AND THE ELECTRON ENERGY LOSS RATE PARAMETER IN THE IONOSPHERE. Sharma, V. N. (Banaras Hindu Univ., India). Int. J. Electron.; 29: 275-9(Sep 1970).

An expression for the ionospheric G factor for air was derived considering the rotational excitations of O_2 and N_2. In view of recent laboratory measurements an expression for $\bar{\nu}_m$ was obtained and an electron collision frequency profile was constructed with the help of pressure data. With these parameters the electron energy loss parameter (Gv/N) of air was calculated which compares well with previous results. It is concluded that the contribution of the rotational excitation of O_2 to the electron energy loss rate parameter is significant for the free electrons with small energies when the electron gas temperature T_e is below 290°K. (auth) (UK)

51526 COMPARISON OF COINCIDENT OGO 3 AND OGO 4 HYDROGEN ION COMPOSITION MEASUREMENTS. Grebowsky, J. M.; Rahman, N. K.; Taylor, H. A. Jr. (Goddard Space Flight Center, Greenbelt, Md.). Planet. Space Sci.; 18: 965-76(Jul 1970).

Ion composition measurements made on August 8, 1967 and August 28, 1967 by the topside ionospheric polar orbiting satellite OGO 4 and simultaneously by the eccentric orbiting magnetospheric satellite OGO 3 were compared on nightside passes through the plasmasphere. Throughout most of the midlatitude regions sampled, an isothermal diffusive equilibrium model at an ion temperature of 1000°K provides a good approximation for coupling these ionospheric regions. However temperature gradient components directed upwards along the field lines of the order of 1°K/km or greater are required to bring the profiles into agreement near the plasmapause assuming diffusive equilibrium and assuming the magnitude of the temperature gradient does not vary along the field line. Similar gradients are also required along the low-latitude field lines traversed on the August 28, 1967 passes. In agreement with previous studies of the average local time asymmetry of the plasmasphere boundary, the plasmapause L coordinates measured by OGO 3 near midnight were greater than the L coordinates associated with the light ion troughs observed near dawn on the coincident OGO 4 pass. In the steady state, if field line preservation is assumed and the convection streamline pattern in the equatorial plane is known, the H^+ densities measured at different local times along the OGO 3 trajectory can be transformed into densities at a local time characteristic of the OGO 4 measurements so that the transformed OGO 3 plasmapause is located on the same field line as the plasmapause determined from the OGO 4 measurements. (auth) (UK)

51527 NEW PLASMA INSTABILITIES IN THE SOLAR WIND. Hollweg, Joseph V.; Voelk, H. J. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). J. Geophys. Res.; 75: 5297-5309(1 Oct 1970).

The instability of transverse electromagnetic waves propagating parallel to the average magnetic field in an electron–proton plasma and the question of whether the instabilities may occur in the solar wind are discussed. The discussion is based on Stix' well-known dispersion relation, but it is assumed that the resonant protons lie near the peak of their distribution function. Three instabilities are found, two of which are new. The first new instability is driven by anisotropic electrons in the same manner as is the firehose, and it possibly represents an extension of the firehose instability to large wave numbers. The growth rates are large over a broad frequency range around Ω_p. It is suggested that the excitation of this instability results in a partial transfer of thermal energy from the electrons to the protons and, if it occurs in the solar wind, may therefore heat the solar-wind protons and reduce their anisotropy. The second new instability is driven by anisotropic protons with $T_{\perp p} \gtrsim 3T_{\parallel p}$; it may occur in local regions of the solar wind. The third instability is not new; it represents a continuation of the unstable whistler mode near Ω_p to those cases where there are many resonant protons. In contrast to earlier work, in which it is assumed that the number of resonant protons is small, this work demonstrates that this instability can in fact be effective in destroying proton anisotropies of the type observed in the solar wind. (auth)

51528 RADIAL DIFFUSION OF OUTER-ZONE ELECTRONS: AN EMPIRICAL APPROACH TO THIRD-INVARIANT VIOLATION. Lanzerotti, L. J. (Bell Telephone Labs., Murray Hill, N. J.); Maclennan, C. G.; Schulz, Michael. J. Geophys. Res.; 75: 5351-71(1 Oct 1970).

The near-equatorial fluxes of outer-zone electrons (E > 0.5 MeV and E > 1.9 MeV) measured by an instrument on the satellite Explorer 15 following the geomagnetic storm of December 17 and 18, 1962, are used to determine the electron radial diffusion coefficients and electron lifetimes as functions of L for selected values of the conserved first invariant μ. For each value of μ, the diffusion coefficient is assumed to be time-independent and representable in the form $D = D_0 L^n$. The diffusion coefficients and lifetimes are then simultaneously obtained by requiring that the L-dependent reciprocal electron lifetime, as determined from the Fokker–Planck equation, deviate minimally from a constant in time. Applied to the data, these few assumptions yield a value of D that is smaller by approximately a factor of 10 than the value recently found by Newkirk and Walt in a separate analysis of 1.6-MeV electron data obtained during the same time period on another satellite. The electron lifetimes are found to be strong functions of L, with 4- to 6-day lifetimes observed at the higher L values (4.6 to 4.8). (auth)

51529 VIRIAL THEOREM APPLIED TO MAGNETOSPHERIC DYNAMICS. Siscoe, G. L. (McDonnell Douglas Astronautics Co., Santa Monica, Calif.). J. Geophys. Res.; 75: 5340-50 (1 Oct 1970).

The application of the virial theorem to the magnetosphere was extended to the study of a closed magnetosphere. The result is used to express the field at the Earth due to external current systems in terms of various self energies of the external systems. The special case of an isolated ring current reduces to the usual result. A new expression is obtained for the boundary current contribution and for the combined ring and boundary currents. Energy considerations are given that lead to an estimate of the size of the ring current effect on geomagnetic sudden impulses and sudden commencements. (auth)

51530 TWENTY-SEVEN-DAY DEVIATIONS OF THE INTERPLANETARY MAGNETIC FIELD AND PLASMAS FROM THE PARKER SPIRAL MODEL. Rosenberg, Ronald L. (Univ. of California, Los Angeles). J. Geophys. Res.; 75: 5310-18(1 Oct 1970).

The orientation of the interplanetary magnetic field was studied by using magnetometer data from Mariners 2, 4, and 5. The magnetic field B and the solar wind velocity V were measured in the right-handed, solar equatorial coordinate system with unit vectors $\hat{r}$, $\hat{\theta}$, and $\hat{\phi}$. The tangent of the spiral angle, $\tan \alpha_B = -B_\phi/B_r$, is given by the Parker model as $\tan \alpha_p = \Omega r \sin \theta / V_r$, where Ω is the Sun's angular velocity and r is the spacecraft–Sun distance. The results of the observations made with Mariners 2, 4, and 5 are that at quiet periods of low solar activity, i.e., when slow solar wind streams dominate the flow, $\tan \alpha_B < \tan \alpha_p$; for disturbed periods of high solar activity, i.e., when fast solar wind streams dominate, $\tan \alpha_B > \tan \alpha_p$. The time intervals during which these coherent deviations occur ranged from about 3 days to 27 days, and as much as several solar rotation periods. The difference between α_B and α_p may possibly be explained by conservation of magnetic flux and by means similar to those used to describe fast-mode blast waves. A portion of the theory presented deals with the nonzero value obtained when B_θ ("north-south" component near the ecliptic) was averaged over 27 days for the + and − polarity fields. The nonzero B_θ, specifically $B_{\theta S} = (B_{\theta+} - B_{\theta-})/2$, is explained in terms of Alfvén shocks $(b_\theta = -(4\pi\rho)^{1/2} v_\theta P$, where ρ is the plasma density, and P is the field's polarity, +1 or −1), and the sign of the velocity component v_θ is analyzed. (auth)

51531 EVIDENCE FOR A GEOMAGNETIC WAKE AT 500 EARTH RADII. Siscoe, G. L. (Univ. of California, Los Angeles); Scarf, F. L.; Intriligator, D. S.; (and others). J. Geophys. Res.; 75: 5319-30(1 Oct 1970).

A comparison of the Explorer 35 solar-wind plasma data with the data obtained by Pioneer 8 during a pass through the tail region at a geocentric distance of 500 R_E suggests the presence of a geomagnetic wake. The wake was characterized by a reduced density of increased temperature or both and by an almost unmodified flow speed as compared with upstream values. The change in density or temperature was of the order of 2 to 4. The wake is discussed in relation to the drag on the magnetosphere. A simple hydrodynamic calculation of wave drag effects gives approximate agreement with observed magnitudes, but the wake region appears to be somewhat larger than expected. Possible effects to account for this include heat diffusion out of the wake and a two-fluid effect in which ions are heated more than electrons at the bow shock. The data do not provide evidence for a viscous boundary layer in the usual sense, but a magnetic surface drag is not excluded. Finally, the possibility of local heating at the boundary is shown to be incapable of accounting for all wake features. (auth)

51532 HYDROMAGNETIC OSCILLATIONS OF THE GEOMAGNETIC TAIL AND PLASMA SHEET. McKenzie, J. F. (European Space Research Inst., Frascati, Italy). J. Geophys. Res.; 75: 5331-9(1 Oct 1970).

Dispersion equations are derived for hydromagnetic oscillations of the geomagnetic tail and plasma sheet by representing the tail as a long cylindrical curent-vortex sheet and the sheet as a slab of hot plasma surrounded by cold, magnetized plasma. It is shown that a cylindrical geomagnetic tail is stable if the speed of the hot gas flowing outside the cylinder is less than the Alfvén speed in the tail, and that the characteristic period is about 13 min for disturbances with wavelengths of the order of the diameter. The model of the plasma sheet yields periods of 6 min for the sausage mode, and 3 min for the kink mode, for wavelengths of the order of the thickness of the sheet. (auth)

51533 PROTON ENERGY DISTRIBUTIONS FROM 0.060 TO 3.3 MeV AT 6.6 EARTH RADII. Stevens, John R. (Aerospace Corp., El Segundo, Calif.); Martina, E. Frank; White, R. Stephen J. Geophys. Res.; 75: 5373-85(1 Oct 1970).

Proton differential fluxes are reported for 12 energies from 0.060 to 3.3 MeV at 6.6 Earth radii for the time period of October 2 to 13, 1968. The proton energies were measured with a surface-barrier semiconductor detector and a stacked-discriminator pulse-height analyzer on the Air Force Office of Aerospace Research Satellite OV2-5 (1968-81A). The typical quiet-time fluxes decreased by 8 orders of magnitude over the measured energy interval. During this time the energy spectrum varied from $E^{-3.5}$ to $E^{-6.0}$. Below 200 keV the energy distributions flatten but never peak above the energy of the lowest channel, 68 keV. Energy spectra associated with the two magnetic storms on October 2 and 12 are presented. After the storms the fluxes were higher than before; this is particularly true at the lower energies measured. Quiet-time pitch-angle distributions near the local noon–midnight meridian clearly show the east–west effect caused by the radial gradient in the fluxes. The pitch-angle distributions at local midnight show the drift loss cone predicted by Roederer. This experiment provides the first confirmation of the Roederer [1967] model of shell splitting in the Earth's magnetic field by measured proton angular distributions. (auth)

51534 STUDY OF THE HIGH-LATITUDE, OUTER-ZONE BOUNDARY REGION FOR ≥40-keV ELECTRONS WITH SATELLITE INJUN 3. Fritz, Theodore A. (National Research Council of Canada, Ottawa). J. Geophys. Res.; 75: 5387-5400 (1 Oct 1970).

The ϕ boundary was introduced in 1968 as a more meaningful concept of the high-latitude limit to durably trapped ≥40-keV electrons than the usual intensity cutoff. In the present study, this boundary is defined more precisely by using four different features of the latitude profile of the ϕ parameter. Two additional high-latitude boundaries, the intensity cutoff (Λ_c) and the background boundary (Λ_{bkg}) for ≥40-keV electrons are defined, and the average positions of each of these six "boundaries" are investigated as a function of invariant latitude, magnetic local time, and magnetic activity. A frequency of occurrence of isotropic and near-isotropic pitch-angle distributions for ≥40-keV electrons is also investigated as a function of magnetic local time and magnetic activity. The results of this study suggest that at least two separate mechanisms control the position of the high-latitude boundary as a function of magnetic local time. One mechanism operates continuously near midnight, but its effectiveness decreases monotonically with increasing local time through dawn and noon, then reaches a minimum in effectiveness in the late afternoon and dusk hours. A second mechanism operates only near the noon meridian (0800 to 1400 hours) and is the dominant mechanism in this local-time interval. There is also an indication that the orientation and symmetry axis of the boundary may change with time. (auth)

51535 ELECTRON OBSERVATIONS BETWEEN THE INNER EDGE OF THE PLASMA SHEET AND THE PLASMASPHERE. Schield, M. A.; Frank, L. A. (Univ. of Iowa, Iowa City). J. Geophys. Res.; 75: 5401-14(1 Oct 1970).

Observations of electron intensities over the energy range ~100 eV to 50 keV are presented for L values between 3 and 10 R_E (Earth radii) near local midnight at low magnetic latitudes. These measurements were obtained over the period June 11 through July 23, 1966, with an array of electrostatic analyzers borne on the Earth satellite Ogo 3. The earthward edge of the plasma sheet is characterized by severe decreases in electron energy densities with decreasing geocentric radial distance. These decreases have a distinct structure with fluxes of higher energy electrons decreasing further from the Earth for the electron energy range ~700 eV to 20 keV. A trough of ~100-eV electrons with number densities of $\sim 1(cm)^{-3}$ is observed to fill the region between the earthward edge of the plasma sheet and the plasmasphere. The densities of electrons with energies greater than 700 eV are often less than 0.1 $(cm)^{-3}$ in this region. The observed separation between the inner edge of the plasma sheet and the plasmapause was ~1 to 3 R_E in June and ~3 to 5 R_E in July. Analysis of subsequent observations should determine whether this is a latitude or local time effect. The plasmapause is usually observed to be located at the minimum of the energy density profile for electrons with energies above 700 eV. At electron energies of ~200 eV a plasmapause structure comprising a sharp radially outward boundary and a broader inward boundary is observed. The observed lifetimes of ~10 days for lower energy electron ($E \sim 1$ keV) intensities in the plasmasphere that were enhanced during a moderate geomagnetic storm are similar to previously reported lifetimes for more energetic electron ($E \geq 500$ keV) intensities in the same region. Kilovolt electron intensities between the plasmasphere and the earthward edge of the plasma sheet decreased more rapidly and fell to typically quiescent values within the satellite's orbital period of 48 hours. Simultaneous observations of the angular distributions of electron intensities at two pitch angles in the plasma sheet revealed that these angular distributions approached isotropy for the several plasma sheet crossings that were examined. Differential energy spectrums of electron intensities for the plasma sheet, the earthward edge, the electron trough and the plasmasphere are also presented. (auth)

51536 ROCKET MEASUREMENTS OF AURORAL ELECTRIC AND MAGNETIC FIELDS. Potter, Wentworth E. (Univ. of New Hampshire, Durham). J. Geophys. Res.; 75: 5415-31 (1 Oct 1970).

A series of five Nike–Tomahawk sounding rockets were launched from Fort Churchill into a variety of auroral conditions. Payload instrumentation included electric field meters, magnetometers, auroral photometers, and charged-particle detectors. Horizontal dc electric fields were measured and were found to point southward during negative magnetic bays. This is consistent with the presence of westward-flowing Hall currents. The relative absence of electric-field variations with altitude indicates that field mapping along nearly equipotential magnetic field lines may be taking place. Perturbations measured by the rocket magnetometers and photometers suggest that the auroral electrojet often flows parallel to visible auroral forms and is comprised of a series of thin current filaments of varying intensity. According to the magnetometer records, horizontal electrojet currents of 10^4 to 10^6 amp existed during periods of visible auroral activity. An upper limit for a field-aligned current in a zenith auroral display 10 km from the payload was calculated to be 2.5×10^5 amp on the basis of flux-gate magnetometer data. Results from a solid-state particle detector, however, suggest that the current was probably of much smaller magnitude. Calculations using various current models indicate that it is often necessary to propose the existence of two or more horizontal current filaments to produce agreement between ground-station and rocket magnetic records. (auth)

51537 EFFECTS OF DYNAMO-REGION ELECTRIC FIELDS ON THE MAGNETOSPHERE. Matsushita, S.; Tarpley, J. D. (National Center for Atmospheric Research, Boulder, Colo.). J. Geophys. Res.; 75: 5433-43(1 Oct 1970).

Based on reasonable models of anisotropic electrical conductivities and solar and lunar tidal wind systems in the dynamo region (90 to 150 km altitude), distributions of electrostatic fields for S_q and lunar variations on quiet days in equinoctial months during moderate sunspot periods are estimated. These electrostatic fields produced in the dynamo region may be communicated to the magnetosphere along the Earth's magnetic lines of force without appreciable attenuation. The communicated electrostatic field distributions in the magnetosphere are deduced, and drift motions of magnetospheric plasma particles caused by the coupling of the Earth's magnetic and electrostatic fields are computed. An outward drift flow in the daytime and an inward

flow at night with a speed of a few meters per second to several hundred occur for S_q. The drift speed for lunar variations is about 5% of that for S_q. (auth)

51538 STATISTICAL STUDY OF MICROPULSATION POLARIZATIONS. Rankin, D.; Kurtz, R. (Univ. of Alberta, Edmonton). J. Geophys. Res.; 75: 5444-58(1 Oct 1970).

The polarization characteristics of a broad band of micropulsations are investigated statistically. Physically realizable quantities such as direction of polarization and sense of polarization, which are derived from the theory, are presented in a digital sonograph display. When averaging is done over a large number of samples, a natural division occurs in the time period display at about 30 sec. (auth)

51539 PARAMETRIC WAVE AMPLIFICATION AND MIXING IN THE IONOSPHERE. Harker, K. J.; Crawford, F. W. (Stanford Univ., Calif.). J. Geophys. Res.; 75: 5459-74(1 Oct 1970).

An analysis is presented of the nonlinear interaction between right- or left-hand polarized transverse electromagnetic waves and longitudinal (Langmuir) plasma waves propagating in the ionosphere. The object is to determine the feasibility of observing parametric amplification or frequency mixing due to such interactions, using ground-based transmitters and receivers. It is shown theoretically that wave coupling should occur in three situations: first, when the highest-frequency component is the plasma wave and the two lower-frequencies are right- and left-hand polarized waves, respectively; second, when the highest frequency component and one other are right-hand polarized and the third is a plasma wave; and, third, when the highest frequency component and one other are left-hand polarized and the third is a plasma wave. The first case shows the weakest coupling, and seems unlikely to be observable. The second and third give rise to somewhat stronger effects, but for typical transmitter and ionospheric parameters suggest the necessity of measuring increments in wave amplitudes due to nonlinear coupling only of order 0.01%. It is concluded that, although, under the most favorable conditions, such phenomena may be observable, they will not generally be significant. (auth)

51540 F-REGION AIRGLOW OBSERVATIONS FROM OSO 5. Sparrow, J. G.; Ney, E. P.; Burnett, G. B.; Stoddart, J. W. (Univ. of Minnesota, Minneapolis). J. Geophys. Res.; 75: 5475-82(1 Oct 1970).

Observations from the Minnesota zodiacal light and airglow experiment on OSO 5 indicate two F-region night airglow emissions of intensity up to 50 rayleighs in equatorial and mid-latitudes. It is suggested that the frequently occurring red emission (in the band 6000 to 8500 A) may be the continuum from the radiative attachment of atomic oxygen. The blue emission (in the band 3500 to 5000 A) is interpreted as being the 3914 A N_2^+ band arising from the precipitation of electrons in selected geographic areas. (auth)

51541 PLASMA MEASUREMENTS WITH THE RETARDING POTENTIAL ANALYZER ON OGO 6. Hanson, W. B.; Sanatani, S.; Zuccaro, D.; Flowerday, T. W. (Univ. of Texas, Dallas). J. Geophys. Res.; 75: 5483-5501(1 Oct 1970).

The nature of the results from the retarding potential analyzer on OGO 6 are described. The device appears to be capable of measuring ion temperature to an accuracy of better than 10% in a quiet ionosphere. In the dawn–dusk plane the ion temperature is observed to vary from 1000 to 4000°K; the higher temperatures are associated with higher altitudes in the winter hemisphere. Molecular ions are detected near perigee (400 km), but their concentrations seldom exceed 1% of the O^+ ion concentration. At midlatitudes and higher altitudes (>700 km) the lighter ions H^+ and He^+ are both present at approximately the O^+ concentration, but their relative importance decreases near and in the polar regions. Both polar regions display large spatial fluctuations in ion concentration, and this behavior extends somewhat into the plasmasphere. Fluxes of electrons with energy greater than 10 eV of the order of 10^8 cm^{-2} sec^{-1} are observed; the fluxes change rather smoothly within the plasmasphere but show rapid and large variations at higher latitudes. The device also operates in a mode that examines the horizontal changes in ion concentration (fractional changes as small as 10^{-3} can be observed) with a spatial resolution from 350 to as small as 40 meters, depending on the telemetry rate. (auth)

51542 METEORIC IONS ABOVE THE F2 PEAK. Hanson, W. B.; Sanatani, S. (Univ. of Texas, Dallas). J. Geophys. Res.; 75: 5503-9(1 Oct 1970).

Heavy ions of about mass 56 amu (probably iron ions) are observed at heights well above the F2 peak at concentrations of the order of 10^2 cm^{-3}. Another ion (or ions) of intermediate mass (~30 amu) and comparable concentration is also observed, but its identification is now obscure. The heavy ions are a common feature of the nighttime ionosphere, and it is suggested that they arise from meteor disintegration near 100 km and are then lifted by the dynamo electric field to greater heights. Readily resolvable structure in the variation of ion temperature with latitude is also observed, and it is postulated that these enhancements in T_i may be caused by the relative drift motions of ions with respect to the neutral atmosphere. (auth)

51543 LATITUDINAL DEPENDENCE OF THE DIURNAL DENSITY VARIATION. Newton, George P. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res.; 75: 5510-16 (1 Oct 1970).

Atmospheric density measurements from the density gages on the Explorer 32 satellite were used to determine in part the latitudinal dependence of the diurnal density variation. The data cover the period May to October 1966. The midlatitude densities for summer in the northern hemisphere confirm the diurnal variation reported from analysis of satellite drag data. However, the data for high northern latitudes (61°) show that the diurnal density variation is less than expected, and that the night-time densities are greater than expected (the day to night temperature ratio is 1.02). These effects cause a latitudinal gradient in the diurnally averaged densities with increasing density toward the pole. The diurnally averaged density values are consistent with a heat source at high latitude and have a tendency to be better ordered with geomagnetic latitude. This indicates that perhaps a persistent heat source for the neutral atmosphere is associated with the auroral zone. (auth)

51544 NEUTRAL AIR DENSITY AND COMPOSITION AT 150 KILOMETERS. von Zahn, U. (Univ., Bonn). J. Geophys. Res.; 75: 5517-27(1 Oct 1970).

Mass densities derived from drag data are compared with densities determined by mass spectrometers, euv extinction measurements, and observations of the growth of chemiluminescent clouds for an altitude of 150 km. Drag densities fall very close to the Cira 1965 mean atmosphere and are 10 to 20% higher than the average for all rocket measurements discussed. Mass spectrometric and euv extinction measurements agree quite well for $n(N_2)$ and $n(O_2)$ but differ significantly for n(O). In order to derive an improved set of parameters of thermospheric density and composition, it is proposed that the Cira 1965 mean density be lowered by 10%, that the measured $n(N_2)$ and $n(O_2)$ number densities be maintained, and that n(O) be chosen such that the number densities become consistent with the mass density ρ. This results in the following reference set for 150-km altitude: $\rho = 1.96 \times 10^{-12}$ g cm^{-3}; $n(N_2) = 2.6 \times 10^{10}$ cm^{-3}; $n(O) = 2.3 \times 10^{10}$ cm^{-3}; $n(O_2) = 2.5 \times 10^{9}$ cm^{-3}; $n(Ar) = 5 \times 10^{7}$ cm^{-3}; mean molecular weight M = 22.9 g $mole^{-1}$. (auth)

51545 LOWER THERMOSPHERE COMPOSITION AND DENSITY ABOVE SARDINIA IN OCTOBER 1967. Bitterberg, W.; Brutchhausen, K.; Offermann, D.; von Zahn, U. (Univ., Bonn). J. Geophys. Res.; 75: 5528-34(1 Oct 1970).

On October 4 and October 10, 1967, the composition of the lower thermosphere above Salto di Quirra, Sardinia (40°N), was measured by mass spectrometers. N_2, O_2, O, Ar, and He densities are presented. Compared with Cira 1965, the N_2 densities reach the model values or are higher by a factor of 1.3, the O_2 densities are lower by a factor of 2 to 3, the O densities are higher by a factor 1.1 to 1.3, the Ar densities are lower by a factor of 3 to 7, and the He densities are higher by a factor of 1.5 to 3. Helium was in diffusive equilibrium with the other constituents of the thermosphere. (auth)

51546 IONOSPHERIC RESPONSE TO INTERNAL GRAVITY WAVES. I. THE F_2 REGION RESPONSE. Hooke, William H. (Inst. for Telecommunication Sciences, Boulder, Colo.). J. Geophys. Res.; 75: 5535-44(1 Oct 1970).

The F_2 region ionospheric response to individual internal gravity waves is calculated as a function of the azimuth of wave propagation. This response is shown to be highly anisotropic, with the anisotropy itself depending on the wave parameters, the geomagnetic dip, and the prevailing ionization density gradient. Because the ionization density gradient changes with time of day and season, the ionospheric response and hence the traveling ionospheric disturbance statistics themselves should exhibit corresponding diurnal and seasonal variations. The physical basis for the anisotropy of the ionospheric response is discussed. (auth)

51547 INTERNAL GRAVITY-WAVE MOTIONS INDUCED IN THE EARTH'S ATMOSPHERE BY A SOLAR ECLIPSE. Chimonas, G. (Univ. of Toronto). J. Geophys. Res.; 75: 5545-51(1 Oct 1970).

In a solar eclipse, the Moon shields a limited region of the Earth's atmosphere from the heating effect of the solar radiation. This shadow travels through the Earth's lower atmosphere at supersonic velocity, causing the neutral gas to emit internal gravity waves that form a bow wave about the shadow region. Tentative estimates of the amplitude of this wave indicate that it will be detectable well outside the area where the eclipse can be observed directly. (auth)

51548 DEPENDENCE OF ELF EMISSIONS ON THE LOCATION OF THE PLASMAPAUSE. McPherson, D. A.; Koons, H. C. (Aerospace Corp., El Segundo, Calif.). J. Geophys. Res.; 75: 5559-64(1 Oct 1970).

Observations of elf emissions at 1.3 kHz are made at altitudes below 1500 km by a receiver on board spacecraft OV3 3. Correlations of the emissions with local time, magnetic latitude, and the planetary magnetic index Kp show that they have the same characteristic dependence with these parameters as has chorus observed by other satellites. The altitude dependence of the magnetic field intensity agrees with that predicted for a wave propagating completely trapped on a tube of force without attenuation. In a few instances, simultaneous measurements of electromagnetic field intensities, wave propagation direction, and electron density were available to show that the emissions were propagating in the whistler mode. The most interesting feature of the emissions is their dependence on the position of the plasmapause. For high Kp, the probability of occurrence increases as the plasmapause moves to a lower L value. The peak intensity of the emission occurs near the plasmapause. (auth)

51549 RESPONSE OF WINDS IN THE 90- TO 140-km ALTITUDE REGION TO VARIATIONS IN SOLAR ACTIVITY. Hicks, J. E.; Justus, C. G. (Georgia Inst. of Tech., Atlanta). J. Geophys. Res.; 75: 5565-70(1 Oct 1970).

Winds determined from 52 photographically tracked trails of rocket-borne chemical releases in the 90- to 140-km altitude range, launched between October of 1962 and June of 1966, are used in both a correlation analysis and a linear regression analysis with several solar and geomagnetic disturbance indices. Results indicate that the altitude interval considered may be broken up into two distinctly different regions of solar influence: the regions above and below 110 km. Significant increases in the geomagnetic index Kp over a 15-hour interval centered on a time lag of 21 hours after increases in atmospheric circulation below 110 km suggest either a dynamo-type of interaction or an increase in the geomagnetic field strength, produced by corpuscular radiation which lags behind the electromagnetic radiation and accompanying atmospheric circulation variations. Apparently continuous associations, with indicated periods of about one solar rotation, between both the solar radio noise index $F_{10.7}$ and the Zurich sunspot number R_z and the northward wind component magnitude above 110 km indicate that long-term variations in the winds in this region are related to similar variations in solar euv radiation. (auth)

51550 EVIDENCE FOR THE LARGE-SCALE AZIMUTHAL DRIFT OF ELECTRON PRECIPITATION DURING MAGNETOSPHERIC SUBSTORMS. Rosen, L. H.; Winckler, J. R. (Univ. of Minnesota, Minneapolis). J. Geophys. Res.; 75: 5576-81 (1 Oct 1970).

Data taken by the Alaskan chain of riometers and satellites are used to study evidence for the large-scale azimuthal drift of electron precipitation during magnetospheric substorms. The events occurred during March and April 1967 and showed that a 1-to-1 correspondence existed between the 50- to 150-keV electron flux increases at the ATS 1 orbit and riometer absorption events near the ATS 1 field line occurring during magnetospheric substorms. A correlation was found between the magnitude of the absorption event and the magnitude of the electron increase on the ATS. The latitude extent of the riometer absorption was investigated and found to have a local time dependence. The apparent north–south progression of precipitation onset is discussed in detail, and it is concluded that the drifting rain cloud concept is believed to have considerable validity for the time sequence of energetic electron events during a magnetospheric substorm. The continual pitch-angle scattering of the electrons into the loss cone implies an activation process that may require an energetic reservoir in addition to that available in the >50-keV electrons. (J.C.W.)

51551 ALFVEN VELOCITY IN THE MAGNETOSPHERE AND ITS RELATIONSHIP TO ELF EMISSION. Burton, Rande K. (Univ. of California, Los Angeles); Russell, Christopher T.; Chappell, Charles R. J. Geophys. Res.; 75: 5582-6(1 Oct 1970)

Ogo 5 measurements of the ion density and magnetic field strength near the equator in the dawn quadrant of the magnetosphere were used to determine the Alfvén velocity. The Alfvén velocity in the outer magnetosphere ranges between 1000 and 2000 km/sec. At decreasing radial distances the Alfvén velocity increases to a maximum (average, 4800 km/sec) and drops to a minimum (average, 490 km/sec) just inside the plasmasphere. ELF emissions are well ordered by the Alfvén velocity profiles. ELF chorus from 100 to 1000 Hz exists in the outer magnetosphere only for Alfvén velocities below about 3000 km/sec. ELF hiss is found immediately inside the plasmapause. This relationship between ELF emissions and the Alfvén velocity is further support for unstable wave generation by Doppler-shifted cyclotron resonance. (auth)

51552 DIURNAL VARIATION OF THE EXOSPHERIC NEUTRAL HYDROGEN TEMPERATURE. Metzger, P. H.; Clark, M. A. (Aerospace Corp., Los Angeles). J. Geophys. Res.; 75: 5587-91(1 Oct 1970).

Resonance filter data obtained from Ogo 6 imply a mean exospheric temperature of 900°K for June 8, 1969, with a 200°K variation dawn to dusk between 0600 and 1800 LT near the equator. Owing to the tilt of the orbit plane by approximately 1 hour toward the summer pole, a north–south asymmetry of about 75°K is also seen. These data strongly suggest that sources of Lyman α external to the geocorona are smaller than previously thought. (auth)

51553 GROWTH PHASE OF MAGNETOSPHERIC SUBSTORMS. McPherron, Robert L. (Univ. of California, Los Angeles). J. Geophys. Res.; 75: 5592-9(1 Oct 1970).

Evidence is presented that suggests that polar magnetic substorms have a significant growth phase prior to the expansion phase. Following observations of the Sept. 6, 1966 polar magnetic substorm at 0240 UT, it is concluded that, following intervals of magnetic calm, the horizontal component of the magnetic field experiences significant deviations prior to the start of the expansion phase of a magnetospheric substorm. The sign of the deviations in various local time sectors does not differ from that in later stages of the substorm. It is concluded that these deviations are likely to be caused by the same current systems, and it seems appropriate to name this initial part of a substorm the growth phase. Six other events in 1967 are considered and establish the existence of the growth phase of a polar magnetic substorm. (J.C.W.)

51554 STATISTICAL ANALYSIS OF MOVEMENTS OF THE IONOSPHERIC TROUGH AND THE PLASMAPAUSE. Rycroft, Michael J.; Burnell, S. Jocelyn (Univ. of Southampton, Eng.). J. Geophys. Res.; 75: 5600-4(1 Oct 1970).

Data obtained from electron density profiles in the topside ionosphere between 1000 km and the peak of the F layer are used to confirm the position of the trough. Electron densities at 500 and 1000 km are compared and it is found that troughs at both altitudes usually occur on the same ionogram, or sometimes on consecutive ionograms taken 18 sec apart, corresponding to a traversal of the satellite of ~0.3 in L value. Observations for the analysis were made when the satellite was over the North American continent during April to August, 1963. The convection of plasma earthwards from the geomagnetic tail is believed to be the phenomenon that drives these current systems. The phenomenon also determines the latitude of the field line through the trough and plasmapause. Statistically, it is shown that the centers of the ionospheric trough and the magnetospheric plasmapause tend to lie, between 2100 and 0500 hours local time, on a certain line of force of the geomagnetic field, the precise position of which also depends on magnetic activity. (J.C.W.)

51555 SOME SPECTROMETRIC RESULTS FROM THE NASA 1968 AIRBORNE AURORAL EXPEDITION. Dick, K. A. (Kitt Peak National Observatory, Tucson, Ariz.). J. Geophys. Res.; 75: 5605-8(1 Oct 1970).

Spectrophotometer measurements taken aboard NASA's 1968 airborne auroral expedition included measurements of numerous weak auroral features. The ratio of the intensities of the permitted O I line at 4368 A and of the N_2^+ 1NG (0,1) band at 4278 A was 1:60 under a variety of auroral conditions. The forbidden N I line at 3466 A varied in intensity relative to the 4278-A band. Its variation follows O I 6300 A, and it may be used as an indicator of precipitating electron energy changes. The continuum at 6700 A was found to have a value $<\frac{1}{2}$ R/A in an area through which an arc had recently passed. A technical report, (Technical Report 24, Department of Physics, Johns Hopkins University) gives details of results at the disposal of other experimenters. (auth)

51556 TENTATIVE IDENTIFICATION OF SEVERAL N_2 $c'\,^1\Sigma_u^+ \rightarrow a\,^1\Pi_g$ BANDS IN AURORAS. Dick, K. A. (Kitt Peak National Observatory, Tucson, Ariz.). J. Geophys. Res.; 75: 5609-11(1 Oct 1970).

Tentative identification of two bands of the N_2 $c'\,{}^1\Sigma_u^+ - a\,{}^1\Pi_g$ system was made from auroral spectrometer results. The (0,0) band at 2827 A was identified on a spectrum taken aboard an Aerobee sounding rocket (4.163) flown from Fort Churchill in February 1967. The (0,2) band at 3119 A was found on some averaged spectra taken during the NASA 1968 airborne auroral expedition. Estimates of the intensities of these very weak bands show each to be ~(0.2 to 0.5)% as intense as the N_2 second positive system. (auth)

51557 EVIDENCE OF VERTICAL ELECTROMAGNETIC DRIFT EFFECT ON THE FORMATION OF F-REGION EQUATORIAL ANOMALY. Wu, Mao-fou (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Res.; 75: 5612-17(1 Oct 1970).

Ionized particles produced at heights below the F2 peak by solar radiation can be lifted by the electromagnetic force $E \times B$ early in the day and then slide down along the geomagnetic field lines and accumulate at about 300-km height and about 15° on either side of the equator. This is Martyn's theory and individual examples are presented to support the theory. Simultaneous analyses of electron density distribution and the horizontal geomagnetic intensity fluctuation data during quiet days over the equatorial region are made. It is found that the anomaly feature is pronounced whenever the amplitude of the H field is large, and vice versa. It is considered that the electromagnetic transport mechanism is the physical cause of the equatorial anomaly in the F region. (J.C.W.)

51558 PHASE DELAY BETWEEN NEUTRAL TEMPERATURE AND NEUTRAL DENSITY AT THERMOSPHERIC HEIGHTS. Volland, H. (Univ., Bonn). J. Geophys. Res.; 75: 5618-20 (1 Oct 1970).

Observations, calculations, and measurements are discussed on the phase delay between neutral temperature and neutral density at thermospheric heights. In the calculations of Volland, the transition height is at about 200 km. Above that height, the euv-generated wave gives rise to a maximum in the density at 1400 LT, that agrees with the measurements. Therefore, wave energy from below cannot explain the difference in the maximum times of density and temperature. A plot of LT versus the exospheric temperature T_∞ of the Jacchia model is given. The plot shows the exospheric temperature T_∞ of the Jacchia model at the equator during moderate solar activity and averaged ion temperature T_i at 250-km altitude deduced from Thomson backscatter observations in Arecibo during moderate solar activity. It is concluded that the observed phase lag between the neutral diurnal thermospheric temperature and density variations is an effect mainly of the higher harmonics in the Fourier development and may be interpreted dynamically as being due to the frequency-dependent response time of the thermospheric circuit system to a realistic solar heat input. (J.C.W.)

51559 LONG-PERIOD SOUND WAVES IN THE THERMOSPHERE FROM APOLLO LAUNCHES. Tolstoy, I. (Florida State Univ., Tallahassee); Montes, H.; Rao, G.; Willis, E. J. Geophys. Res.; 75: 5621-5(1 Oct 1970).

Doppler shift ionospheric sounders running at 4.824 and 6.030 MHz and operated out of Westwood, New Jersey have recorded extremely low-frequency acoustic arrivals of the Saturn–Apollo 12 and 13 launches. The geometry of the Doppler sounder reflection points and microbarograph array is presented and is somewhat dispersive. The standard techniques of deducing dispersion cannot be applied due to the nature of the source, which is a supersonic disturbance moving rapidly in both horizontal and vertical dimensions. The horizontal projection of the significant path extends from Cape Kennedy to Bermuda, and the component of source velocity in the direction of Westwood results in Doppler shifting of the source spectrum. The vertical component of motion of the source introduces a modulation of each mode. For the high velocities involved, the modulation frequency can be of the order of the field frequencies being studied. It is difficult to distinguish frequency changes in time due to dispersion from those due to source effects and to resolve the resulting multiplicity modes. It is concluded that the disturbance in the 4.0- to 1.5-min bandpass is channeled near the mesopause and the lower thermosphere. (J.C.W.)

51560 ROLE OF SHORT-WAVELENGTH X RAYS IN THE D-REGION IONIZATION. Gangully, S. (National Physical Lab., New Delhi). J. Geophys. Res.; 75: 5626-30(1 Oct 1970).

A comparative analysis of the dependence of MF A_1 absorption for four different stations (Colombo, Alma-Ata, Freiburg, and De-Bilt) on short-wavelength x rays (0 to 8 and 8 to 20 A) and on the general solar activity (10.7 cm flux) is presented. The results indicate that, even for the equatorial station of Colombo, more than 75% of the total production rate is controlled by sources other than the x rays, whereas the x-ray contribution to the total ionization budget sharply decreases with increase in latitude. Some inferences are drawn regarding the variation of minor constituent concentration with latitude under the assumption that Lyman α and uv are the other dominating radiations. (auth)

51561 MONTHLY MEANS OF THE GEOMAGNETIC FIELD. McDonald, Keith L. (Earth Sciences Labs., Boulder, Colo.). J. Geophys. Res.; 75: 5631-3(1 Oct 1970).

Monthly means of the hourly values of the horizontal and radial intensity of the geomagnetic field are presented graphically from 10 European observatories of close proximity. To ascertain whether a perturbation was of global extent, comparison was made with observatories at Hermanus, Agincourt, Amberly, and stations operated by the US. Plots are presented here for 1945 to 1967, but previous data are available. Examination of continuous-run observatories records reveals that the deeper global horizontal intensity depressions are due to a near rash of magnetic storms of augmented frequency during the lifetime of the depression, and the inference is made that they are associated with active regions on the Sun that occur at random geographical positions. The phenomenon necessarily results from disturbances at great depths in the Sun, possibly in the hydrogen reactor, and the time dispersion of the perturbations at the surface resulting possibly from different turbulent paths. It can be seen that the curves of horizontal intensity clearly detect global perturbations. (J.C.W.)

51562 DISCUSSION OF LETTER BY KUNITOMO SAKURAI, CHARACTERISTICS OF THE X-RAY AND Hα EMISSIONS ASSOCIATED WITH SOLAR PROTON FLARES. Kahler, S. (Naval Research Lab., Washington, D. C.). J. Geophys. Res.; 75: 5637-43(1 Oct 1970).

The conclusion drawn by K. Sakurai, NSA 24: 10273, "that the acceleration efficiency of energetic protons and heavier nuclei is closely connected with the rise time of the increase of both Hα and x-ray emissions associated with the development of solar proton flares" is challenged by the author on three separate counts. It is stated that the data analysis methods are unclear, that similar analysis of different proton events and their associated flares fails to confirm the results, and the results obtained are not necessarily expected from an observational point of view. Charts and figures are presented from K. Sakurai's work as references for the new conclusions presented. A reply by Sakurai is included. (J.C.W.)

Low-Temperature Physics

Refer also to abstracts 50653 and 51866.

51563 (CEA-CONF-1577) DETERMINATION OF OPTIMAL PERFORMANCES OF CRYOGENIC CONTAINERS WITH NECKS. Conte, Rolland Rene; Blot, Robert; Mignen, Jean (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1970. 16p. (CONF-700523-2). Dep. CFSTI (U. S. Sales Only).

From 3rd International Cryogenic Engineering Conference, West Berlin, Germany.

The determination of the boiloff induced in cryogenic containers with a neck was based on the two following points: the thermal conductibility integral of the neck's material was used instead of a linear approximation; curves were plotted in order to determine the boiloff of the container ($Q_C - Q_C + Q_R$) for any value of the power Q_R transmitted through the insulation of the inner vessel. Q_C is the energy transmitted by conduction through the solid and Q_C the freezing power generating from the heat escaping through the neck. The cryogenics fluids used were: helium between 4.2 and 78°K and between 4.2 and 300°K, hydrogen between 20 and 300°K, nitrogen between 90 and 300°K and argon between 87 and 300°K. Different curves were plotted at various values of Z = A/L(cm) (neck section/neck length), and for different heat exchanges: perfect or zero. For the helium calculations between 4.2 and 78°K, a coefficient $\alpha(0 < \alpha < 1)$ representing the efficiency of the heat exchange was introduced. Some experiments are described on this particular point. (France)

51564 (COO-1569-59) EXPERIMENTAL AND THEORETICAL STUDIES IN SOLID STATE AND LOW TEMPERATURE PHYSICS. Annual Progress Report, 1970. (Minnesota Univ., Minneapolis. Inst. of Tech.). Sep 1970. Contract AT(11-1)-1569. 48p. Dep. CFSTI.

COBALT ISOTOPES Co-60—internal field in gold and copper in magnetic fields

COPPER—cobalt-60 internal field in magnetic field in
—manganese nuclear orientation in
CRYSTALS—theory of quantum, research on
—ground state of quantum, pair-variational calculations
ELECTRONS—mobility in gaseous helium at low temperatures, many-body calculations
GOLD—cobalt-60 internal field in magnetic field in
HELIUM—research on liquid and solid
—electron mobility in low-temperature gaseous, many-body calculations
HELIUM ISOTOPES He-3—^{3}He–^{4}He, spin waves in liquid
—^{3}He–^{4}He, thermal capacity of liquid, near junction of lambda and phase-separation curves
HELIUM ISOTOPES ^{4}He—energy level of liquid, calculations of ground-state
—^{3}He–^{4}He, spin waves in liquid
—^{3}He–^{4}He, thermal capacity of liquid, near junction of lambda and phase-separation curves
LOW TEMPERATURE PHYSICS—research at Minnesota Univ. on
MANGANESE—nuclear orientation measurements in copper
NIOBIUM NITRIDES—superconductivity of films of, in 2-D and 3-D regimes
PRASEODYMIUM—demagnetization cooling of
SOLID-STATE PHYSICS—research at Minnesota Univ. on
SUPERCONDUCTORS—research at Minnesota Univ. on
—behavior of niobium nitride films in 2-D and 3-D regimes
SUPERFLUIDITY—research at Minnesota Univ. on
YTTERBIUM FERRATES—thermal capacity of $YbFeO_3$ in spin-reorientation region (L.M.T.)

51565 (IPP-4/76) SUPERCONDUCTING COIL STABILITY AND INTERACTION BETWEEN THE TRANSPORT CURRENT AND DIAMAGNETIC CURRENTS. Martinelli, A. P. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Apr 1970. 37p. Dep. CFSTI (U. S. Sales Only).

A number of stability tests were made on superconducting samples (Nb–25% Zr, Nb–48% Ti, stabilized and nonstabilized) of single-layer coils in which a critical state was reached by applying transport current I and transverse field H in the procedures (I–H), (H–I), and H and I simultaneously (coil simulation). By using the coil simulation procedure, and also pulsed fields, indirect experimental evidence is given of minimum stability of the parts of the coil winding located in the 15- to 20-kOe region. The test results are related to results of similar tests reported in the literature. Particular attention is devoted to the interaction between the transport current and diamagnetic currents and to its effect on stability. The results suggest an additional general approach to the known methods of stabilizing coils by scaling the superconductor cross section to the transverse field. This approach should make it possible, by reducing the diamagnetic currents in the superconductor, to attain better field homogeneity and improve material utilization and coil stability. (auth)

51566 (NYO–3029-44) FLUCTUATIONS NEAR THE ONSET OF THE RESISTIVE TRANSITION IN FILAMENTARY SUPERCONDUCTORS. Report No. 1437. Lukens, J. E.; Warburton, R. J.; Webb, W. W. (Cornell Univ., Ithaca, N. Y. Materials Science Center). 19 Aug 1970. 7p. Dep. NTIS.

Measurements of the onset of the resistive transition and the current–voltage characteristics of "one-dimensional" single crystal tin whiskers, extended to a sensitivity of 10^{-15} volts, have directly revealed the predicted thermally activated quantum phase slips of magnitude 2π and have verified a theory for the rate of phase slippage based on the Ginsburg–Landau equations. (auth)

51567 (ORO–3665-23) A STUDY OF VERY PURE METALS AT LOW TEMPERATURES. Progress Report. (Georgetown Univ., Washington, D. C. Dept. of Physics). [1970]. Contract AT(40-1)-3665. 116p. Dep. CFSTI.

In the process of searching for a slight depression of the superconducting critical temperature (T_c) in gallium alloyed with small amounts of indium and rapidly frozen to 77 K, it was found that no superconducting transition existed near the gallium transition of 1°K. Instead, the data (primarily ac susceptibility measurements) indicated two possible superconducting transitions, one at 4 to 6°K and one above 25°K. Moreover, the "transition" above 25°K could be shifted with magnetic field H so that H was propertional to T_c^2, just as one would expect for a superconductor. Because of the importance of a high-T_c superconductor, efforts were concentrated proving (or disproving) that these transitions were indeed due to superconductivity. A series of specific heat, dc magnetization, and resistivity measurements were done. The results of these experiments, as well as the progress in other areas, are summarized under the following subjects: the transition at 25°K, the transition at 4 to 6°K, tunneling studies, boundary scattering studies, and theoretical work. (M.H.R.)

51568 (TID–25549) SUPERCONDUCTIVE TUNNELING INTO BULK GALLIUM SINGLE CRYSTALS. Keister, Jamieson Charles (Georgetown Univ., Washington, D. C.). May 1970. Contract AT(40-1)-3665. 107p. Dep. NTIS.

Thesis.

Characteristic Giaever tunneling curves were obtained with high-impedance bulk gallium tunneling samples, yielding estimates of the alpha-phase gallium energy gap consistent with estimates obtained by others. Other effects, such as sample-aging processes, excess tunneling currents, weak-link behavior, and possible multiple-gap structure were observed. A fabrication process for tunnel junctions was developed that may be extended to other materials. The general problem of interpreting bulk tunneling data must be worked out before a great deal of credence can be placed on the variation of the energy gap as a function of specific crystal orientation. Further efforts to improve fabrication processes, lower sample impedances, improve temperature measuring techniques, and lower the measuring temperatures are necessary before obtaining extensive data on energy gap as a function of crystal orientation for bulk gallium. (auth)

51569 PROXIMITY EFFECT IN LIQUID HELIUM IN A CHANNEL WITH A PERIODICALLY CHANGED CROSS SECTION. Kiknadze, L. V.; Mamaladze, Yu. G.; Cheishvili, O. D. Soobshch. Akad. Nauk Gruz. SSR; 59: 49–52(Jul 1970). (In Russian).

Transition from superfluidity to the normal state is considered in a channel with a periodically changing cross section when—due to the quantum effect of proximity—the wide section of the channel prevents transition to the normal state in its narrow sections. (auth)

51570 USE OF FERROMAGNETIC MATERIALS IN STABILIZING HIGH-FIELD SUPERCONDUCTING MAGNETS. Donaldson, G. W. (New South Wales Univ., Kensington, Australia); Graham, C. D.; Hart, H. R. Inst. Radio Elec. Eng., Aust., Proc.; 31: 177-81(Jun 1970).

The performance of superconducting magnets has been limited by the occurrence of unpredictable instabilities known as flux jumps. The maximum magnet current often falls far short of the current reached when short samples of the superconductor are tested. It was shown that the introduction of a small proportion of ferromagnetic material, although often fully saturated, reduced the component of field strength perpendicular to the flat surface and gave a definite improvement in performance to magnets wound with flat tape superconductors. The field remaining after the magnet series current was reduced to zero was due to lossless circulating supercurrents, and is known as the trapped field. It was shown that reduced trapped fields had some bearing on performance after the magnet current had been reversed. (auth) (Australia)

51571 TEMPERATURE VARIATION OF THE dc JOSEPHSON CURRENT IN Pb–Pb TUNNEL JUNCTIONS. Lim, C. S. (Univ. of Waterloo, Ont.); Leslie, J. D.; Smith, H. J. T.; Vashishta, P.; Carbotte, J. P. Phys. Rev., B; 2: 1651-6(15 Sep 1970).

The temperature variation of the dc Josephson current $J_s(T)$ of Pb–Pb tunnel junctions has been investigated both experimentally and theoretically. The experimental data do not agree with the temperature dependence of the dc Josephson current derived by Ambegaokar and Baratoff for the case of two weak coupling superconductors. However, detailed numerical calculations of the temperature variation of the dc Josephson current for a Pb–Pb tunnel junction, which employ strong coupling superconductivity theory throughout, are in reasonably good agreement with the experimental measurements. (auth)

51572 ROLE OF COLLECTIVE OSCILLATIONS IN THE ELECTRON MECHANISM OF SUPERCONDUCTIVITY. Geilikman, B. T. (Inst. for Atomic Energy, Moscow). Phys. Status Solidi; 41: 419-23(1 Sep 1970).

The spectrum of collective oscillations for a metal with overlapping (broad and narrow) bands is found. The essential influence of acoustical plasmons on the pairing in the high-temperature electronic mechanism of superconductivity for such metals is shown. The conditions for high-temperature superconductivity in the case of metal–nonmetal compounds, specifically with organic substances, are discussed. (auth)

51573 SUPERCONDUCTIVITY IN THE DILUTE LEAD REGION OF Cu-BASED Cu–Si–Pb ALLOYS. Rapp, Oesten (Royal Inst. of Tech., Stockholm). Ark. Fys.; 39: 241-56(1969).

The resistance as a function of temperature was measured for a set of alloys of Cu–Si–Pb in a highly cold-worked state in the

lead concentration range below 0.60 at.%. It is observed that the critical temperature decreases with decreasing lead concentration. The transition is gradually more incomplete when the lead concentration decreases, but superconducting effects are apparent even for 0.05 at.% Pb alloys. The effect of cold work was investigated on 0.28 at.% Pb alloys within a large cold-working range. With increasing cold work, the resistive width of the resistance temperature transitions increases. For moderate cold work there is only a small effect or no effect on the critical temperature. Above a certain degree of cold work, however, the critical temperature decreases with increasing cold work. Resistive measurements in longitudinal magnetic fields for these latter specimens show a decrease of the critical field with increasing cold work close to the critical temperature and an increase of the critical field with increasing cold work at lower temperatures. Some indications of the preserved integrity of the two phases are given by the phase diagram and microphotograms and by the observation that under this assumption the critical field is inversely proportional to the diameter of the lead precipitates over a certain range of cold work. Reasons are given why internal stresses are less likely to explain the results. Instead it is noticed that a proximity effect could possibly explain all effects observed on T_c. (auth)

51574 SUPERCONDUCTIVE CIRCUIT. Sole, Jean (to Commissariat a l'Energie Atomique). British Patent 1,191,446. 13 May 1970. Priority date 15 Mar 1968, France.

A superconducting circuit is described that includes at least one winding of a conducting element of superconducting material. This element has an outer electrically insulating sheathing and is in the form of a continuous hollow tube in which a cooling fluid flows in the immediate vicinity of the superconducting material. The ends of the element are electrically connected without affecting the cooling fluid circuit by connecting the outer surfaces of the ends at regions where there is no sheathing. Thus, the inlet and outlet for the cooling fluid remain independent of each other. (M.H.R.)

51575 SUPERCONDUCTOR GATING OR SWITCHING DEVICES. Artley, John L. (to U. S. Atomic Energy Commission). U. S. Patent 3,505,538. 7 Apr 1970. Filed 25 Apr 1967.

Coherent domain wall motion or the establishment of such a domain wall in a thin-film ferromagnetic material, as controlled by an applied magnetic field, is utilized to effect switching of the current in a superconducting thin-film gate circuit. The thin-film ferromagnetic material is placed adjacent to the superconducting thin film of the gate circuit with a thin film of insulating material between. The switching that is effected is such that an effective open or closed circuit can be retained, as desired. (AEC)

51576 SUPERCONDUCTIVITY AND MAGNETIC SUSCEPTIBILITY OF Zr_2Co–Zr_2Ni SYSTEM. Yamaya, Kazuhiko; Sambongi, Takashi; Mitsui, Tadayasui (Hokkaido Univ., Sapporo). J. Phys. Soc. Jap.; 29: 879-84(Oct 1970).

The superconducting transition temperature, T_c, the magnetic susceptibility and lattice constants were measured. T_c strongly depends upon the density of states at the Fermi surface estimated from the magnetic susceptibility. The electron interaction parameter of the Bardeen–Cooper–Schrieffer theory of superconductivity was found to be approximately 0.09 eV/atom for all the compounds investigated. The dependence of the volume of unit cell upon electron concentration is similar to that of T_c and the density of states over the concentration range investigated. These results are consistent with a two-band model of superconductivity in transition metals, proposed by J. Kondo. (auth)

51577 FAST-NEUTRON DAMAGE AND THE CURRENT-CARRYING CAPACITY OF NIOBIUM NITRIDE. Sadagopan, V. (Massachusetts Inst. of Tech., Cambridge); Gatos, H. C.; Hechler, K.; Saur, E. Z. Phys.; 225: 231-6(1969).

Niobium nitride samples were irradiated with fast neutrons to a total dosage of 3.7×10^{19} NVT. The current-carrying capacity of the samples before and after irradiation was determined. Significant enhancement of the current-carrying capacity of the samples was found to result from irradiation (particularly in the 30- to 80-kGauss range) apparently due to neutron-induced defects acting as pinning centers for the fluxons. (auth)

51578 COMPARISON BETWEEN MEASURED AND CALCULATED RF LOSSES IN THE SUPERCONDUCTING STATE. Halbritter, J. (Univ., Karlsruhe, Ger. Kernforschungszentrale, Karlsruhe, Ger.). Z. Phys.; 238: 466-76(1970).

Results of experiments and of the BCS theory on the surface resistance of superconductors are presented. It will be shown that agreement between theory and experiment can be achieved by using revised material parameters. In the case of lead and niobium it is shown that the rf absorption decreases markedly with decreasing mean free path l. This dependence on mean free path can become a method to measure l in a surface sheath. (auth)

51579 PROPAGATION OF MAGNETIC FLUX ON A LONG JOSEPHSON TUNNEL JUNCTION. Scott, A. C. (CNR, Naples). Nuovo Cim.; 69B: 241-61(11 Oct 1970).

It is shown that "wave of permanent profile" solutions for the propagation of magnetic flux on a lossless, one-dimensional Josephson tunnel junction exist only for pulses which contain a single flux quantum. Quasi-linear equations are developed for the envelope of a pulse that contains many flux quanta. The Baecklund transformation is used to obtain an analytic expression for a pulse with two flux quanta and to derive additional conservation laws for pulses with many flux quanta. (auth)

51580 TIME-DEPENDENT GINZBURG–LANDAU EQUATION AND NORMAL-STATE CORRELATION FUNCTION. Tilley, D. R. (Philips Research Labs., Eindhoven, Netherlands). Z. Phys.; 238: 399-403(1970).

It is shown that the kernel of the integral equation for the time-dependent pair potential can be expressed in terms of a retarded classical normal-state correlation function, as conjectured by Bergmann. The proof makes the same assumptions as the corresponding proof for the time-independent equation. (auth)

51581 NEW RELAXATION EFFECT IN THE SOUND ATTENUATION IN LIQUID ^{4}He UNDER PRESSURE. Roach, Pat R.; Ketterson, J. B.; Kuchnir, M. (Argonne National Lab., Ill.). Phys. Rev. Lett.; 25: 1002-5(12 Oct 1970).

Observation of the first-sound attenuation in liquid ^{4}He under pressure has revealed a new relaxation mechanism which is not predicted by any present theory. (auth)

51582 EFFECT OF MAGNETORESISTANCE ON DIFFERENTIAL RESISTANCE OF A TYPE-I SUPERCONDUCTOR (TIN). Ho, L. C.; Meincke, P. P. M. (Univ. of Toronto). Phys. Lett.; 32A: 454-5(7 Sep 1970).

The effect of magnetoresistance was observed in a type-I superconductor, in which the differential resistance decreases more slowly with field in the intermediate state than in the normal state. (auth)

51583 SURFACE STUDIES ON NIOBIUM AND SOME IMPLICATIONS FOR SUPERCONDUCTIVITY. Dickey, J. M.; Farrell, H. H.; Kammerer, O. F.; Strongin, M. (Brookhaven National Lab., Upton, N. Y.). Phys. Lett.; 32A: 483-4(7 Sep 1970).

A combined low-energy electron diffraction (LEED), Auger spectroscopy study of surface oxide structures and their removal as a function of temperature is reported. By measuring how the intensities of LEED spots vary as a function of temperature, the Debye–Waller factor and the effective Debye temperature, θ_D, are obtained at the niobium surface. (M.H.R.)

51584 SPECIFIC HEAT SINGULARITIES IN SUPERCONDUCTORS NEAR T_c. Grossmann, S.; Richter, P. H. (Philpps-Univ., Marburg, Ger.). Phys. Lett.; 33A: 39-40(21 Sep 1970).

In contrast to Thouless' estimate of the specific heat for pure superconductors, the singularities for dirty material may occur in experimentally accessible temperature intervals. The Ginzburg–Landau theory is used to calculate the excess specific heat of nonpure samples due to fluctuations of the order parameter. (auth)

51585 TEMPERATURE DEPENDENCE OF THE MAGNETIC FIELD AT A VORTEX CENTER IN TYPE-II SUPERCONDUCTING VANADIUM BY NMR. Kung, Albert (Columbia Univ., New York). Phys. Rev. Lett.; 25: 1006-7(12 Oct 1970).

The field at a vortex center, h_v, was measured in a vanadium foil sample and extrapolated to zero temperature and zero flux density. For an isolated vortex at $T = 0$, $h = 1780 \pm 240$ G. At all flux densities it appears that $\partial h_v/\partial T$ is nonzero, even as $T \to 0$. (auth)

51586 SUPERCONDUCTIVITY: THE TRANSITION TEMPERATURE PEAK BELOW FOUR ELECTRONS PER ATOM. Cooper, A. S.; Corenzwit, E.; Longinotti, L. D.; Matthias, B. T.; Zachariasen, W. H. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Proc. Nat. Acad. Sci. U. S. A.; 67: 313-19(Sep 1970).

It is shown that the superconducting transition temperature for compounds in seven different structure types exhibits a peak at about 3.7 to 3.9 valence electrons per atom. (auth)

51587 SPECIFIC HEAT IN MAGNETIC FIELD OF A HIGHLY REVERSIBLE TYPE-II SUPERCONDUCTING ALLOY. Ehrat, R.; Rinderer, L. (Univ., Lausanne, Switzerland). Phys. Lett.; 32A: 547-8(7 Sep 1970).

Detailed measurements of the specific heat at the mixed–normal phase transition were done with increasing and decreasing temperature on a $Nb_{80}Mo_{20}$ alloy. Experimental values of the specific heat jump are compared with those calculated from the GLAG theory, particularly in the vicinity of T_c. (auth)

51588 THIN-FILM SUPERCONDUCTORS. Ricci, M. V.; Sacchetti, N. (CNEN, Frascati, Italy). Alta Freq.; 39: 511-20(Jun 1970). (In Italian).

The principal properties of thin-film superconductors and their possible applications are reviewed. The first part is devoted to a discussion of transition temperature, critical fields, and critical currents, whereas the second part describes the use of thin-film superconductors in devices such as amplifiers, radiation detectors, cryotrons, bolometers, etc. (31 references) (tr-auth)

51589 EFFECT OF SURFACE PROTRUSIONS ON THE CURRENT DISTRIBUTION IN A LONDON SUPERCONDUCTOR. Appel, J. (Gulf General Atomic Inc., San Diego, Calif.). J. Appl. Phys.; 41: 4856-9(Nov 1970).

The current density and the magnetic field strength are calculated in a type-I superconductor which has the form of a long cylinder with a sinusoidal surface contour. London's and Maxwell's equations are solved with a straightforward perturbation calculation. The amplitude of a protrusion Δ is assumed to be small compared with the penetration depth λ. The results show a sizable variation of current and field near the surface when Δ/λ and λ/L (L = wavelength of protrusion) are both ≥ 0.1. (auth)

51590 TRANSITION TEMPERATURE OF STRONGLY COUPLED SUPERCONDUCTORS. Geilikman, B. T.; Masharov, N. F. (Inst. for Atomic Energy, Moscow). Phys. Status Solidi; 41: K31-4(1 Sep 1970).

The equation for the renormalized pairing self-energy part, derived from Eliashberg's equations at the transition temperature, is given. It is assumed that the phonon spectrum is described approximately by one Einstein peak. The influence of the Coulomb interaction for strongly coupled superconductors is neglected. It is pointed out that the effective coupling constant is the eigenvalue of the homogeneous sum Fredholm equation of the second kind with nondegenerated kernel. Therefore, T_c may be derived from the calculation the eigenvalue of the equation. The complexity of the kernel equation makes it difficult to obtain this relation in exact form. The approximate Kellog method is used for the integral equations, which can be applied without changes for the sum equations. The normalized zeroth approximation was chosen for the eigenfunction of the equation and an iterative procedure is used. The relation for the calculation of T_c is derived and some details of the iterative procedure are shown. (M.H.R.)

51591 SOUND VELOCITY, DENSITY, AND GRUENEISEN CONSTANT IN LIQUID ^{4}He: COMPARISON OF EXPERIMENT WITH THEORETICALLY CALCULATED RESULTS. Roach, Pat R. (Argonne National Lab., Ill.); Ketterson, J. B.; Woo, Chia-wei. Phys. Rev., A; 2: 543-5(Aug 1970).

An experimental determination of the pressure dependence of the sound velocity $c(P)$, the density $\rho(P)$, and the Grueneisen constant $u(P)$, of liquid ^{4}He has been reported recently. It is straightforward to deduce the ground-state energy from these data: $[E(\rho) - E(\rho_0)]/N = \int_{\rho_0}^{\rho} [P(\rho')/\rho'^2]\, d\rho'$, where $\rho_0 = 0.02185$ Å^{-3} is the experimental density at zero pressure, and $E(\rho_0)/N$ is taken to be -7.14°K. The following expression was found to give a very precise fit of the results: $(1/N)\, E(\rho) = -7.14 + 13.65(\rho - \rho_0/\rho_0)^2 + 7.67(\rho - \rho_0/\rho_0)^3$, where all coefficients are in °K. The experimental energies of this equation are compared to two sets of theoretical results. (M.H.R.)

51592 SUPERCONDUCTING TAPE FOR HIGH MAGNETIC FIELDS. Des. Components Eng.; No. 17, 51-3(17 Sep 1969).

The superconducting properties and uses of Nb–Sn alloys are discussed. The material can be conveniently handled in the form of a layer 0.005-mm-thick on a ductile substrate, and can be prepared by diffusing Sn into a Nb ribbon to produce the superconducting coating and leave sufficient Nb for support. (Metals Abstr.)

51593 ANOMALOUS PARACONDUCTIVITY OF SUPERCONDUCTING WHISKERS ABOVE T_c. Cook, J. W. Jr. (Clemson Univ., S. C.); Skove, M. J.; Stillwell, E. P.; Thompson, R. S. Phys. Lett; 32A: 445-7(7 Sep 1970).

Tin whiskers show anomalously broad resistive transitions which narrow in a magnetic field. This indicates that the fluctuation paraconductivity would be divergent except for the presence of pair-breaking interactions. (auth)

51594 RESIDUAL GAS CONDUCTION AND RADIATION NEAR LIQUID HELIUM TEMPERATURE. Pirtle III, Francis William. Lafayette, Ind.; Purdue Univ. (1969). 277p. University Microfilms Order No. 70-8948.

Thesis.

Residual gas conduction and radiation heat transfer were investigated for temperatures near the normal boiling temperature of helium. The combined heat transfer between concentric cylinders was measured as a function of the pressure of helium gas in the space between the cylinders. A calorimetric technique is used. The temperature of the inner cylinder varies between 8.8 and 5.2°K. The outer cylinder temperature is 4.2°K. The temperature change of the inner cylinder is used to determine the amount of heat transferred. The temperature of the inner cylinder is measured by using foils with various superconducting transition temperatures placed in the wall of the cylinder. Each foil is located between the primary and secondary coils of an air core transformer. When the foil becomes superconducting it acts as a flux shield. The flux linking the primary and secondary coils decreases to near zero. The voltage output of the secondary coil decreases correspondingly. The temperature of the inner cylinder at a precise time is known from the output voltage change in the secondary coil. The temperature change of the cylinder can be obtained by using two different foil and transformer arrangements. The advantage of this method is that the cylinder temperature can be determined without physical contact with the cylinder. Physical contact with the cylinder would introduce thermal losses greater than the measured heat transfer. (TSS) (Diss. Abstr. Int., B)

51595 CURRENT–PHASE RELATIONSHIP IN SHORT SUPERCONDUCTING WEAK LINKS. Baratoff, Alexis (Brown Univ., Providence); Blackburn, James A.; Schwartz, Brian B. Phys. Rev. Lett.; 25: 1096-9(19 Oct 1970).

A one-dimensional model of a superconducting link is proposed that is weak only insofar as it has a lower critical current than the superconductors on either side. According to appropriate solutions of the Ginzburg–Landau equations, the supercurrent J is a single-valued, odd function of the phase change φ across the link, which goes to zero at $\varphi = 0$ and $\varphi = \pi$ and tends to the Josephson relation $J \propto \sin\varphi$ in the limit of a very weak link. (auth)

51596 EFFECT OF LOCALIZED SURFACE CHANGES ON TRANSPORT CURRENT DISTRIBUTIONS IN PLATES OF TYPE-I SUPERCONDUCTORS. Schweitzer, D. G.; Adams, P. D. (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem. Solids; 31: 2161-4(Sep 1970).

Magnetization measurements of hollow cylinders of type-I superconductors show that the induced persistent current distribution is dependent on localized surface conditions and also depends upon wall thickness. Similar effects in transport current measurements in plates of type-I superconductors are reported. The effect of etching and straining the surfaces was examined. The results imply that localized surface effects may contribute to nonuniform eddy currents and nonuniform dissipation in superconductors that carry an appreciable fraction of the current in the surface. (UK)

51597 EFFECT OF ONE-BODY INTERACTIONS ON TRANSITION TEMPERATURE OF SUPERCONDUCTORS. Upadhyaya, U. N.; Sinha, K. P. (National Chemical Lab., Poona). Indian J. Pure Appl. Phys.; 6: 546-9(1968).

The effect of one-body spin independent interactions involving conduction and localized electron states, taken in conjunction with phonon-induced attractive electron–electron interaction, is analyzed by using the method of double-time temperature-dependent Green's functions. The resulting expression for the transition temperature (T_c) of a superconductor contains terms that indicate decrease in T_c emanating from the one-body interaction considered above. (auth)

51598 RADIO-FREQUENCY-SPUTTERED FILMS OF β-TUNGSTEN STRUCTURE COMPOUNDS. Hanak, J. J.; Gittleman, J. I.; Pellicane, J. P.; Bozowski, S. (RCA Labs., Princeton, N. J.). J. Appl. Phys.; 41: 4958-62(Nov 1970).

Radio-frequency sputtering has been used to deposit films of intermetallic binary systems (A_xB_Y) in which the composition varies continuously from about 10 at.% to 80 at.% for the B constituent. Within this composition range, the following β-tungsten structured compounds were obtained: V_3Si, Nb_3Sn, Nb_3Pt, Nb_3Au, Nb_3Al, Nb_3Ge, and Ta_3Ge. For films with thickness ranging from 3000 to 10,000 Å, values of T_c were observed which were within 1°K of previously reported best bulk values. In the case of Ta_3Ge, a new β-W superconductor has been found with a T_c of about 8°K. (auth)

Plasma and Thermonuclear Physics

51599 PLASMA PHYSICS INDEX. VOLUME 5, NO. 8, 1970. Bibliography, Author Index, Subject Index. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1970). 103p.

This listing includes 555 articles on various aspects of plasma physics. (M.O.W.)

51600 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. VOLUME 4, NO. 7, 1970. Bibliography, Author Index, Subject Index, Appendix. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1970). 38p.

This listing includes 182 articles on various aspects of the subject above. (M.O.W.)

Confinement and Heating

51601 (AD-706041) PASSAGE OF AN INTENSE RELATIVISTIC ELECTRON BEAM THROUGH A CUSPED MAGNETIC FIELD. Friedman, Moshe (Cornell Univ., Ithaca, N. Y. Lab. of Plasma Studies). Mar 1970. Contract N00014-67-A-0077-0002. 16p. (LPS-37). NTIS.

A high-intensity, high-current relativistic beam was injected into a cusped magnetic field. Energy detected by a calorimeter was used to determine that 10^{14} electrons are passed through the cusp. Preliminary observations indicate that these electrons produce a cloud of relativistic electrons gyrating in a magnetic field having a small ratio of translational to rotational energies. (auth) (USGRDR)

51602 (AD-706401) RESEARCH ON ELECTRON RICH PLASMA STABILITY. Final Scientific Report, April 1, 1969-March 31, 1970. Janes, G. S. (Avco-Everett Research Lab., Everett, Mass.). Apr 1970. Contract F44620-69-C-0095. 26p. (AFOSR-70-1404-TR). NTIS.

Theoretical and experimental studies were conducted on the production and containment of electron rich plasma in toroidal geometries. Particular emphasis was placed on wave and instability phenomena occurring in this type of plasmas. The experiments demonstrate the existence of toroidal plasma equilibria and show that stability can be ensured under properly controlled plasma conditions, in close agreement with theoretical predictions. (auth) (USGRDR)

51603 (AD-708180) PLASMA CONFINEMENT BY LOCALIZED FEEDBACK CONTROLS. Wang, P. K. C. (California Univ., Los Angeles, School of Engineering and Applied Science). 1 Jun 1970. 10p. (AFOSR-70-1759-TR). NTIS.

The problem of confining a plasma in a specified bounded spatial domain by means of feedback control forces applied over an outer shell of the domain is considered. Using a two-component fluid model for the plasma, various forms of feedback controls are derived by minimizing an instantaneous weighted mean outflow rate over a subregion of the shell. The effects of some of the derived feedback controls on plasma confinement are determined by experiments performed on a two-dimensional computer-simulated plasma. (auth) (USGRDR)

51604 (AD-708522) ELECTROSTATIC-INERTIAL PLASMA CONFINEMENT. Dolan, Thomas J.; Verdeyen, Joseph T.; Cherrington, Blake E.; Meeker, Donald J. (Illinois Univ., Urbana, Gaseous Electronics Lab.). Jun 1970. 142p. (UILU-ENG-70-303; AFOSR-70-1656-TR). NTIS.

Electrostatic-inertial plasma confinement consists of trapping charged particles in potential wells (of the electric field), which are produced by ions or electrons injected radially inwards into a hollow sphere or cylinder, called the grid. Theoretical expressions are derived for the potential, electron density, and ion density as functions of radius, grid voltage and grid current. The main limitations on plasma density are summarized. A neon plasma was produced in cylindrical geometry. A device is proposed that could inject much higher currents at lower pressures. (auth) (USGRDR)

51605 (LA-4510) STUDIES OF TURBULENT HEATING OF HYDROGEN PLASMA BY NUMERICAL SIMULATION. Morse, R. L.; Nielson, C. W. (Los Alamos Scientific Lab., N. Mex.). Sep 1970. Contract W-7405-eng-36. 5p. Dep. NTIS.

One-dimensional numerical simulation of the development of the ion-acoustic instability in a plasma with mass ratio 1836 shows considerable electron heating but only small high-temperature tails or large-amplitude, undamped ion-acoustic waves in the ion distribution. (auth)

51606 (NP-18470) INFLUENCE OF RESONANCE STRUCTURE OF THE MAGNETIC FIELD ON CONFINEMENT OF COLLISIONLESS PLASMA IN TOR-1 STELLARATOR. Preprint No. 117. Andryukhina, E. D.; Soldatskii, I. V.; Fedyanin, O. I.; Khol'nov, Yu. V. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1970. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

Previously, it was postulated that the rosette structure of magnetic surfaces, shifting, and magnetic axis distortions influence plasma lifetime in the rotational transformation region. The influence of rosette structure of the magnetic field on plasma confinement was studied in order to verify the suggested hypothesis. Compensation of resonance magnetic field perturbations at the point of strong resonance, $l = 2r$, was carried out using the Tor-1 stellarator, and the structure of the magnetic field and its influence on plasma confinement were measured. Results showed that, although the plasma is very sensitive to changes in magnetic field structure and its distribution along the cross section of the chamber changed accordingly with changes of magnetic surface, the main integral characteristics of plasma confinement remained unaltered. However, before making any final decision on the influence of field structure on plasma confinement, it is necessary to determine the character of plasma currents on the walls. Specifically, it is desirable to determine if plasma currents on the wall are of diffusion character or, possibly, are constant plasma currents related to the loss of plasma equilibrium. (R.V.J.)

51607 NUMERICAL SIMULATION OF ELECTRON-CYCLOTRON HEATING OF A PLASMA. Shohet, J. L. (CEN, Saclay, France). Phys. Lett.; 32A: 511-12(7 Sep 1970).

A computer model of a plasma is used to demonstrate electron cyclotron heating. The method first solves Poisson's equation for the self-consistent field and then adds in the external rf field. The particles making up the plasma are then moved by a finite-difference scheme. (auth)

51608 MAGNETIC FIELD CONFINEMENT OF LASER IRRADIATED SOLID PARTICLE PLASMAS. Haught, Alan F.; Polk, Donald H.; Fader, Walter J. (United Aircraft Research Labs., East Hartford, Conn.). Phys. Fluids; 13: 2842-57 (Nov 1970).

Laser irradiation of a small solid particle of lithium hydride in vacuum results in the generation of a spherically symmetric, isolated, highly ionized plasma. Experimental studies with such plasmas formed within mirror and minimum-B magnetic field up to 8 kG show that the expanding plasma can be captured by the magnetic field and the expansion kinetic energy thermalized in agreement with a simple magnetohydrodynamic model of the plasma-magnetic field interaction. In the experiments, the major plasma loss occurs through the mirror loss cones, and mass spectrometer measurements show rapid escape of the highly ionized lithium followed by a more gradual decay of hydrogen indicating a scattering mechanism for the plasma decay. Plasmas with densities of 3×10^{13} cm^{-3} at temperatures of 100 eV are confined for lifetimes up to 150 μsec in a minimum-B field compared with the 0.3 μsec lifetime associated with the free plasma expansion. Both the magnitude and the temperature dependence of the plasma decay from a minimum-B containment field are consistent with plasma loss by Coulomb collisional scattering into the magnetic field loss cones. (auth)

51609 PLASMA HEATING WITH COMBINED RADIO-FREQUENCY AND STEADY MAGNETIC FIELDS. Kofoid, M. J. (Boeing Scientific Research Labs., Seattle, Wash.). Phys. Fluids; 13: 2817-25(Nov 1970).

Measurements were made of the power W_p transferred into 5-cm-diam cylindrical discharges in noble gases at $p = 1\mu$ to 500μ pressure, using an axial sinusoidal 0.5 mc/sec magnetic field of intensity $B_\sim$ and a superimposed parallel steady magnetic field of intensity B_0. With a fixed $B_\sim$, W_p passed through a maximum as B_0 was increased from zero; W_p decreased to a negligible value when B_0 was increased to several times the value required for maximum W_p. All the test results support the premise that, aside from some Ohmic heating by annular current flow, the only energy transfer process that was important when $B_\sim$ was less than B_0 was magnetic pumping. The degree of ionization in the test plasmas was ≤17%. The test conditions reasonably complied with the restrictions of the large-amplitude magnetic pumping theory of Gerwin for power transfer into a fully ionized gas; only fair agreement between the predictions of his theory and the results of these experiments could be established. (auth)

51610 CONTRACTION OF POSITIVE DISCHARGE COLUMNS. Kozlov, Yu. G. Opt. Spectrosc. (USSR) (Engl. Transl.); 28: 354-6(Apr 1970).

Translated from Opt. Spektrosk.; 28: 654-8(Apr 1970).

The excitation and ionization processes in the discontinuous contraction of positive discharge columns are discussed. The effects of the nonuniform distribution of T_e and atoms across the discharge tube are described qualitatively, and calculations are made for various values of the parameter b. The dependence of the ionization rate on the electron temperature is shown. Five cases of how the processes affect the electron distribution across the cross section are listed. (D.L.C.)

51611 PRELIMINARY EXPERIMENTS WITH STOCHASTIC PLASMA HEATING. Bocharov, V. N.; Volosov, V. I.; Komin,

A. V.; Panasyuk, V. M.; Yudin, Yu. N. Zh. Tekh. Fiz.; 40: 1334-6(Jun 1970). (In Russian).

Preliminary data obtained on stochastic plasma heating in a toroidal trap (stellarator) showed that the charge ignition intensity as a function of hf generator frequency was in qualitative agreement with the theoretical evaluation ($U \sim f^{-1}$). The plasma density obtained was equal to $\sim 10^8$ to 10^9 cm^{-3}. (tr-auth)

51612 PLASMA INJECTION AND CONFINEMENT IN A CLOSED QUADRUPOLE MAGNETIC TRAP. Goncharenko, V. P.; Demidenko, I. I.; Lomino, N. S.; Padalka, V. G. Zh. Tekh. Fiz.; 40: 1206-16(Jun 1970). (In Russian).

Experimental studies showed that, due to the polarized interaction, plasma clusters injected into a quadrupole magnetic trap are confined in the toroidal region localized near zero magnetic field. Plasma with electron temperature of 5 eV, density exceeding 10^{11} cm^{-3}, and a typical lifetime of ~350 μsec, was confined in the system. The confinement time for a 10-cm wave exceeded 500 μ sec; the confinement stops simultaneously with the intensity of confining magnetic field converting to zero. The plasma did not show any MHD instability. The main plasma losses in the trap were, obviously, confined to particles hitting the brackets and coils of the magnetic field equipment. (tr-auth)

51613 ION HEATING AND DIFFUSION OF LOW-FREQUENCY INSTABILITY IN PLASMA WITH ELECTRON BEAMS. Astrelin, V. T.; Buchel'nikova, N. S.; Kudryavtsev, A. M. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Tekh. Fiz.; 40: 1185-93(Jun 1970). (In Russian).

Studies of the low-frequency instability developing during interactions between electron beam and thermally ionized potassium plasma showed that the observed instability is the result of the heating of plasma electrons by the high-frequency Langmuir oscillation fields. It was found that the instability at comparably low electron temperature was of the drift-type, and at increased temperatures it transformed into ionosonic-type. A rise of transverse temperature of plasma ions was observed during development of the instability. Convective mechanisms of plasma diffusion across the magnetic field and relaxation of oscillations in a plasma pinch were analyzed. (tr-auth)

51614 NONLINEAR RESONANT ION HEATING IN A MAGNETOPLASMA. Jayasimha, P.; Thompson, W. B. (Univ. of California, San Diego, La Jolla). Can. J. Phys.; 48: 1894-1905 (15 Aug 1970).

A calculation is presented of the power absorption by ions in a hot plasma through a nonlinear process in which a wave near the ion cyclotron frequency is excited by the mixing of two high-frequency waves. The high-frequency waves are so selected as to match vacuum waves at a plasma–vacuum boundary. (auth) (Canada)

Diagnostics

51615 (IPP-2/83) THE COLLECTION OF POSITIVE IONS BY MEANS OF SCREENED PROBES. Joshi, V. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Aug 1969. 22p. Dep. CFSTI (U. S. Sales Only).

Using a multiple-grid probe, it was possible to separate the currents flowing from the plasma to the collector into their electron and ion components. Two measuring methods used to achieve this involved, namely: investigating the retardation part of the ion curve and the ratio of electron to ion saturation currents. These studies were made mainly in a thermal cesium plasma obtained by means of contact ionization on a plane tantalum plate. In this plasma the retardation part of the ion current curve plotted as a function of the probe potential was found to be exponential, thus indicating a Maxwellian velocity distribution of the ions. It was possible to evaluate the ion temperature from the slope of the retardation part of the ion curve. This curve was followed by a distinct saturation of the ion current to the collector. The ratio of electron-to-ion saturation current obtained by these measurements was very close to $\sqrt{(m^+/m_-)}$ for cesium. The ion and electron temperatures determined from the probe characteristic were in the vicinity of the temperature of the hot emitter plate, which was at about 2500°K. (auth)

51616 (IPP-4/4) INTERFEROMETRIC AND SCHLIEREN MEASUREMENTS OF THE ELECTRON DENSITY IN ARC PLASMAS USING IR RADATION FROM A CO_2 LASER. Keilmann, Fritz (Institut fuer Plasmaphysik, G.m.b.H, Garching (West Germany)). Mar 1970. 104p. (In German). Dep. CFSTI (U. S. Sales Only).

Infrared radiation with a wavelength of 10 μ can be used to measure plasma electron densities in the region $10^{14} \lesssim n_e \lesssim 10^{18}$ cm^{-3}. The dielectric behavior shows that ions, neutral particles, temperature, and the velocity distribution have little influence on this radiation. Experimentally, such measurements have only recently been made possible by the advent of new techniques in the fields of the CO_2 laser, infrared optics, and infrared image conversion, especially with liquid crystals. The electron distribution in rotational symmetric plasmas can be obtained from the phase shift or beam deflection. Five measuring methods and the relevant evaluation procedures are described. The most sensitive of these are scanning techniques, viz. interferometry with phase-compensating mode of operation and beam deflection with "Minimumstrahlkennzeichnung." Since the characteristic of the image converter cannot readily be calibrated, imaging methods, viz. conventional interferometric and Schlieren systems, yield somewhat less accurate results but require only a very short exposure time (less than 10^{-7} sec). Finally, with certain assumptions, a one-dimensionally focusing deflection method with this exposure time gives directly the electron density distribution along the arc axis. (auth)

51617 (NP-18471) RECORDING OF PLASMA OSCILLATIONS INDUCED BY EXTERNAL SUPER-HIGH-FREQUENCY FIELD. Preprint No. 92. Batanov, G. M.; Sarksyan, K. A.; Silin, V. A. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1970. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

A probe for measuring potential plasma oscillations in the presence of intense external super-high-frequency fields is described. The probe is screened from the external shf field by means of a section of an open coaxial line. Plasma oscillations induced in an inhomogeneous plasma layer by strong shf waves were studied. Plasma oscillations in the $\omega_0 \simeq \omega_{Le}$ region were recorded and, in the case of a strong external field in the region $\omega_0 > \omega_{Le}$, the frequency of the plasma oscillation signal coincided with the frequency of the external radiation ω_0. (tr-auth)

51618 (SC-RR-70-331) BLUNT-BODY ELECTROSTATIC PROBE ANALYSIS. Shelton, George A. Jr. (Sandia Labs., Albuquerque, N. Mex.). Aug 1970. 44p. Dep. NTIS.

The multifluid equations governing the flow of a plasma past a blunt-body, electrostatic probe are presented. The terms describing the interaction between different species are derived in general and the specific expressions for the interactions active in an argon plasma are presented. Approximations applicable to arc jet flows are made which render the system of equations soluble. The resulting equations are solved numerically, and the flow profiles are analyzed to ascertain the physical processes that dominate. (auth)

51619 (SC-RR-70-413-A) FLUSH-MOUNTED ELECTROSTATIC PROBE IN THE PRESENCE OF NEGATIVE IONS. Touryan, K. J.; Chung, P. M. (Sandia Labs., Albuquerque, N. Mex.). Sep 1970. 38p. Dep. NTIS.

The current–voltage characteristics of continuum flush-mounted electrostatic probes are analyzed in the presence of negative ions. It is shown that negative ions suppress the electron saturation current significantly and increase the positive ion saturation slightly. (auth)

51620 (SC-RR-70-583) POSITIVE ION DETECTORS FOR USE WITH DIRECTED PULSED PLASMAS. Lockwood, Grant J. (Sandia Labs., Albuquerque, N. Mex.). Aug 1970. 28p. Dep. NTIS.

A series of detectors developed to measure ion characteristics in a directed pulsed plasma is described. The mechanical design, theory of operation, and a calibration procedure are discussed. The detectors can be used to measure velocity, charge-state distribution, mass distribution, total mass, and total charge. Also included are the results of performance checks using the plasmas from a coaxial rail gun or from laser-induced blowoff. (auth)

51621 LIGHT SCATTERING FROM PLASMAS WITH A NON-MAXWELLIAN VELOCITY DISTRIBUTION. Kegel, Wilhelm H. (Institut fuer Plasmaphysik, Garching, Ger.). Plasma Phys.; 12: 295-304(Apr 1970).

The spectrum of light scattered from a two-component plasma is studied. If the distribution function of the electrons deviates from a Maxwellian, appreciable changes may occur in the spectrum. Special attention is given to the case where the electron distribution function consists of two Maxwellians. If a small fraction (e.g., 5–10 percent) of the electrons has a much lower temperature than the bulk plasma (e.g., $T_{e1}/T_{e0} \sim 0.01$), the central line is enhanced appreciably (up to a factor of 10) and a new resonance maximum appears. There is experimental evidence that such deviations from thermodynamic equilibrium can occur in laboratory plasmas. The effects discussed have consequences for plasma diagnostics by light scattering. (auth) (UK)

51622 NEW METHOD FOR TIME-RESOLVED MEASUREMENTS OF PLASMA ELECTRON ENERGY DISTRIBUTIONS.

Kimmich, K.; Saggau, B. (Univ., Stuttgart). Phys. Lett.; 32A: 509-10(7 Sep 1970).

A method using difference quotient circuits is described for measuring the second derivative of a probe characteristic in time-varying plasmas. (auth)

51623 BEHAVIOR OF A QUADRUPOLAR PROBE IN A HOT ISOTROPIC PLASMA. Storey, Owen; Rooy, Bruno (Centre National de la Recherche Scientifique, Saint-Maur-des-Fosses, France). Compt. Rend., Ser. B; 271: 320-3(3 Aug 1970). (In French).

The effect of nonzero electron temperature on the mutual impedance of a quadrupolar probe in a hot plasma was studied. The dielectric constant $\epsilon(k,\omega)$, and a high-order Cauchy distribution approaching the Maxwell distribution for electron velocities, were used. It was thus possible to specify the conditions associated with a resonance peak at the plasma frequency and to show how the form and height of this peak depend upon the electron temperature. (tr-auth) (France)

51624 ELECTRON DENSITY OF RELATIVISTIC ELECTRON-BEAM-PRODUCED PLASMAS. Rizzo, J. E. (Ion Physics Corp., Burlington, Mass.). J. Appl. Phys.; 41: 4941-5(Nov 1970).

A multiple-pass Mach–Zehnder laser-illuminated interferometer was constructed and used to measure the electron density profile of plasmas produced by a self-confined propagating electron beam. Spatial and time-resolved data were taken perpendicular to the electron beam axis at two longitudinal positions. Densities of 10^{16} cm^{-3} were seen in air between 0.15 and 0.3 torr as early as 150 nsec after the electron beam entrance. Peak densities of 10^{17} cm^{-3} were typically reached at around 2 μsec. Plasma compression was observed under some conditions. (auth)

51625 STUDIES OF CAVITY RESONATORS CONTAINING MAGNETOPLASMAS. Kent, Gordon; Thomas, Donald (Syracuse Univ., N. Y.). J. Appl. Phys.; 41: 4945-53(Nov 1970).

Cylindrical cavity resonators containing weakly ionized gases, principally argon, in the pressure range of 0.03 to 0.70 torr were investigated. The plasma, produced either by microwave or dc power, is magnetized by a uniform axial field. Measurements of resonant frequency, made over a range of plasma densities and magnetic field, are compared with the calculations of the theory given by Kent (J. Appl. Phys. 39: 5919 (1968)). The agreement is good, providing the cylindrical degeneracy of the cavity is preserved and the plasma is reasonably uniform. Experimental and analytical results are used to evaluate perturbation theory, and some simple formulas, useful for diagnostic purposes, are given. A perturbation method for correcting the theory to account for symmetrical nonuniformities is proposed, and it is applied to the experimental data with apparent success. The method offers the possibility of determining both uniformity and density from measurements of frequency in one microwave band. (auth)

51626 DIRECTIONAL LANGMUIR PROBE. Hudis, Martin; Lidsky, L. M. (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys.; 41: 5011-17(Nov 1970).

The theory for an asymmetric Langmuir probe is developed for the case of a collisionless streaming high-density ($a_i > R_p > 30\lambda_d$) plasma with $T_i < T_e$. The results are used to analyze the response of the probe to a mildly turbulent drifting plasma. Ion saturation current is a function of the angle between the streaming direction and the probe asymmetry axis and has the form $V_j^i = (T_e/T_i)^{1/2}(V_s/4)(\Delta I_s^i/I_s^i)$. The operation of the probe is verified by measurements of a known plasma-drift velocity and found to be accurate within a factor of three. (auth)

51627 PLASMA PARAMETERS FROM rf CONDUCTIVITY MEASUREMENTS. Sen, S. N.; Gupta, R. N. (North Bengal Univ., Darjeeling, India). Indian J. Pure Appl. Phys.; 7: 462-7(Jul 1969).

Radio frequency conductivity measurements were made in the case of 3 ionized gases, viz. helium, neon, and argon, over the pressure range of a few microns to 700 μ and under an external magnetic field varying from 0 to 550 gauss. From the experimentally determined values of σ_r, the real part of rf conductivity, it has been possible to calculate the electron density, the collision frequency and electron temperature and study their variation with pressure, the discharge current and magnetic field. A quantitative theory was proposed to explain the variation of electron temperature with magnetic field and the experimental data compare well with the theoretical variation, especially at low values of pressure and magnetic field. The pressure $(P_H)_{max}$ at which the rf conductivity becomes maximum shifts to higher values with the increase in the magnetic field for all the gases studied. Good quantitative agreement between the values of $(P_H)_{max}$, derived on the basis of the concept of equivalent pressure and variation of random velocity with magnetic field, and the experimental values is observed. The dielectric constant and the Debye shielding distance were obtained from values of σ_r, and their variation with magnetic field and pressure was studied. A qualitative explanation of the variation of these two parameters was suggested. (auth)

51628 MICROWAVE SCATTERING FROM A NONUNIFORM PLASMA. Liddle, P. F. (Flinders Univ. of South Australia, Bedford Park). Aust. J. Phys.; 23: 605-7(Aug 1970).

The plasma density profile is described for scattering of 9.5-GHz microwaves from the positive column of a low-pressure mercury arc. (auth) (Australia)

51629 CATHODIC INTERACTION OF AN ELECTRODE WITH DENSE PLASMA. Rohatgi, Vijay K. (Harvard Univ., Cambridge, Mass.). J. Appl. Phys.; 41: 4826-30(Nov 1970).

Current partitioning at a tungsten cathode in a 1-atm argon plasma is studied experimentally. Both ions and electrons are found to contribute to the cathode current in this case. The ion current is supplied by the plasma whereas the electron current is controlled by the thermionic emission laws. The work function of the emitter is reduced due to the presence of an ion space-charge field in a manner described by the Schottky effect. (auth)

51630 PLASMA PROBING BY TWO ATOMIC BEAMS FOR DETERMINING PINCH SHIFT. Abramov, V. G.; Afrosimov, V. V.; Gladkovskii, I. P.; Kislyakov, A. I. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz.; 40: 1302-4(Jun 1970). (In Russian).

Experiments with the installation Tuman revealed less plasma concentration was anticipated during compression by an increasing magnetic field. However, a shift of plasma pinch, which makes the probing plasma beam pass not along the diameter of the pinch but along its chord may be the cause. In order to verify the assumption on the shift of the pinch, a simultaneous probing was undertaken using two beams of fast hydrogen atoms along the chords distributed symmetrically in relation to the axis of the discharge chamber. The shift observed was small. It was concluded that a considerable amount of plasma particle losses are sustained during constriction. The estimated corresponding diffusion coefficient was identical to the Bohm coefficient $D_B \approx 0.6 \times 10^4$ T/H (T is the temperature and H the magnetic field). (tr-auth)

51631 AXIAL AND RADIAL TEMPERATURE PROFILES IN A WEAKLY IONIZED ARGON JET. Morgan, F. J.; Nicholls, R. W. (York Univ., Downsview, Ont.). Can. J. Phys.; 48: 1845-57(15 Aug 1970).

Diagnostic studies were made on a supersonic (Mach 2.5) weakly ionized plasma jet in argon. Electrical probe techniques were used in conjunction with spectroscopic and photographic methods. The results indicate a fairly uniform axial behavior of temperature, but the radial profiles show considerable variation. Temperature measurements made by different methods disagree sufficiently to show a probable lack of equilibrium between translational, rotational, vibrational, and electronic excitation energy modes. (auth) (Canada)

Kinetics (General)

Refer also to abstract 51613.

51632 (N-70-28240) EXPERIMENTAL AND THEORETICAL INVESTIGATION OF PLASMA RADIATION. Semiannual Status Report, September 1969–February 1970. Griem, Hans R.; Greig, J. R. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Feb 1970. Contract NGR-21-002-073. 6p. (NASA-CR-110002). NTIS.

Measurement of Stark broadening for the resonance lines of neutral argon and neon is reported. Experimental values for wf, the product of the Stark broadening parameter and the oscillator strength for each line, and the values of w derived from this quantity using the most recently measured values of f, the oscillator strength for each line, are tabulated. The plasma conditions for the electromagnetically driven T-tube source used in these determinations are also summarized. Values of the electron temperature obtained from the visible lines emitted by the source and those obtained from the fitted profiles of the saturated emission lines in the vacuum ultraviolet agreed to within 3%. Thus, these saturated uv lines under the T-tube conditions could serve as an intensity standard in this region of the radiation spectrum. (auth) (STAR)

51633 SELF-FOCUSING OF LASER BEAMS IN A PLASMA BY PONDEROMOTIVE FORCES. Hora, Heinrich (Institut fuer Plasmaphysik, Garching, Ger. Rensselaer Polytechnic Inst., Hartford, Conn.). Z. Phys.; 226: 156-9(1969).

Self-focusing of a laser beam in a plasma is treated in terms of the ponderomotive acceleration due to the gradient of the light intensity. The focusing of radiation within the first minima of diffraction sets a lower limit to the laser power, which is of the order of 1 MW for the usual lasers, if cutoff density and a plasma temperature of about 10 eV are assumed. (auth)

51634 DIFFUSION OF DECAYING PLASMA DENSITIES ACROSS MAGNETIC FIELDS. Takeda, S.; Seppelt, B. M. (Univ. of New England, Armidale, Australia). Aust. J. Phys.; 23: 491-6(Aug 1970).

The diffusion of plasma particles in helium gas was investigated by measuring the decaying time of the electron density in decaying plasmas using microwave techniques. The measured decay time constants are compared with values predicted theoretically and seem to indicate a change from ambipolar diffusion to Bohm diffusion with increasing magnetic field, although the variation of the time constants with pressure is greater than expected for Bohm diffusion. An oscillation of the plasma density with a frequency of the order of tens of kilohertz was detected. (auth) (Australia)

51635 TEMPERATURE DEPENDENCE OF DISSOCIATIVE RECOMBINATION. Bardsley, J. N. (Univ. of Pittsburgh). Phys. Rev., A; 2: 1359-65(1 Oct 1970).

Calculations of the dissociative-recombination rate for diatomic molecular ions and electrons are reported for various arrangements of the potential-energy curves. The temperature variation is shown to be different for the two possible heating mechanisms: selective electron heating or total gas heating. An attempt is made to correlate the afterglow and shock-tube measurements of the recombination rate for nitric oxide and neon. This attempt fails, and this suggests the need for further studies. (auth)

Kinetics (Experimental)

Refer also to abstract 51404.

51636 (AD-705693) DIFFUSION IN A MICROWAVE-EXCITED PLASMA. Final Scientific Report. Heintz, Roger F. (Syracuse Univ., N. Y. Dept. of Electrical Engineering). Feb 1970. 53p. (TR-70-2; AFOSR-70-668-TR). NTIS.

The experimental investigation of diffusion in a microwave-excited plasma is reported. The plasma is contained in a microwave cavity and driven in the TM010 mode at approximately 8.4 GHz. The cavity is immersed in a static uniform magnetic field variable up to 3750 G. Gases used in these experiments were argon, helium, and hydrogen at pressures of .02, .16, and .65 torr. The diffusion was determined from measurements of the net power absorbed by a constant-density plasma as a function of magnetic field. Instabilities were observed only in argon at a pressure of .02 torr. For stable plasmas, the power was essentially a monotonic decreasing function of the magnetic field. While some aspects of the experimental results agree with ambipolar diffusion theory, others do not. A marked difference is the strong dependence of the radial density distribution on the magnetic field. Also investigated was the decay of an afterglow helium plasma at .16 and .65 torr. The plasma was observed to decay approximately 2 to 3 times faster than predicted by ambipolar diffusion. (auth) (USGRDR)

51637 (AD-706028) EXPERIMENTAL INVESTIGATION OF THE MASS DISTRIBUTION FROM THE EXHAUST OF A COAXIAL PLASMA ACCELERATOR. Strouse, Robert Dale (Naval Postgraduate School, Monterey, Calif.). Jun 1969. 73p. NTIS.

Thesis.

Investigations were conducted on the mass distribution of the exhaust of a coaxial plasma accelerator in order to gain insight into the manner by which the fuel (gold) is ionized and accelerated. Tests were conducted using both annular sections of gold foil and single strands of gold wire. Both types of runs showed a nonuniform angular distribution with one or more well-defined peaks. The similarity between the distributions leads to the probable conclusion that the foil, rather than undergoing uniform ionization around the annulus, is actually ionizing discreet "spokes" about its periphery. Experiments conducted with gold foil involved varying the distance from the accelerator to the collector. A fairly uniform dispersion of gold plasma was observed as collector distance increased. (auth) (USGRDR)

51638 (AD-706040) PRODUCTION AND FOCUSING OF A HIGH-POWER RELATIVISTIC ANNUAL ELECTRON BEAM. Friedman, Moshe; Ury, Michael (Cornell Univ., Ithaca, N. Y. Lab. of Plasma Studies). Jan 1970. Contract N00014-67-A-0077-0003. 14p. (LPS-36). NTIS.

A new electron beam injection gun was developed to produce pulsed relativistic electron beams with a power of 10^{10}. The annular-shaped beam propagates in a magnetic field with efficiencies approaching 100%, and its radius may be controlled by the magnetic field configuration. Typical results obtained with a 4-inch-diameter cathode are reported. (auth) (USGRDR)

51639 (AD-707086) EXPERIMENTAL INVESTIGATION OF THE MICROWAVE RADIATION EMITTED BY A HIGH-CURRENT RELATIVISTIC ELECTRON BEAM. Nation, John A.; Gardner, Walter L. (Cornell Univ., Ithaca, N. Y. Lab. of Plasma Studies). Apr 1970. Contract N00014-67-A-0077-0002. 37p. (LPS-41). NTIS.

The development of a high frequency in a relativistic electron beam, propagating through a drift space, was studied from measurements of the microwave emission from the beam. The results show that a part of the radiation is emitted from the region close to the beam front and that the intensity of this emission grows in time as it is convected along with the beam. The growth rate is of the order of 100,000,000/sec and depends on the macroscopic flow parameters. Experiments in different gases show that the growth rates are approximately proportional to the ionization probability of the gas. Precursor radiation is also monitored at comparable power levels to those found at the beam front. Possible explanations of the radiation are proffered and the physical importance of the emission (about 100 kw/m length of drift tube) on beam neutralization and structure are indicated. (auth) (USGRDR)

51640 (AD-707091) ELECTRON ENERGY DEPENDENCE OF THE MOMENTUM-TRANSFER CROSS SECTION IN XENON BY MICROWAVE INTERACTION TECHNIQUES. Coffey, Denis M. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Feb 1970. 112p. (AFCRL-PSRP-406; AFCRL-70-107). NTIS.

Microwave conductivity ratios and cyclotron resonance absorption linewidths are measured in xenon afterglow plasmas using microwave propagation and pulsed swept-frequency techniques. The momentum-transfer cross section Q (em) for electrons of energy up to 1 eV is best represented by an electron velocity (m/sec) dependence of Qem (v). The results are in general agreement with the available literature except near the Ramsauer minimum. The dissociative electron-ion recombination in xenon 300°K plasmas was determined. (auth) (USGRDR)

51641 (AD-708032) DYNAMIC EFFECTS OF HIGH NU/GAMMA BEAM PLASMA INTERACTIONS. Final Report, February 1968-August 1969. Yonas, Gerold; Spence, Philip W.; Ecker, Bruce M.; Rander, John S. (Physics International Co., San Leandro, Calif.). Aug 1969. Contract DASA01-68-C-0096. 105p. (PIFR-106-2; DASA-2426). NTIS.

Generation and propagation characteristics of high nu/gamma electron streams were investigated using diode voltage and current diagnostics, net and primary beam current monitors, graphite calorimeters, and thin foil depth dosimeters, and scintillator-photodiode detectors. The effects of beam-plasma interactions of the time and spatial dependence of beam current were measured and correlated with a diffusion-dominated model of current neutralization. Important parameters in the model are primary current risetime, avalanche breakdown time of the background gas, and the plasma conductivity after breakdown. The existence of large primary electron transverse energy components was consistent with a magnetic pressure balance calculation, indicating a dependence on $(nu/gamma)_{net}$ and the degree of current neutralization. Beam energy loss mechanisms are discussed and compared with observed beam energy loss. (auth) (USGRDR)

51642 (N-70-27939) PERFORMANCE AND DIAGNOSTICS OF A WATER-COOLED MAGNETOPLASMADYNAMIC ARC THRUSTER. Connolly, Denis J.; Sovie, Ronald J.; Seikel, George R. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1970. 39p. (NASA-TN-D-5836; E-5561). NTIS.

The performance of a water-cooled MPD arc thruster using ammonia propellant was studied for a range of operating conditions. Thrust efficiency increased with arc power and with mass flow rate. Thrust efficiency also increased with increasing specific impulse if the specific impulse was raised by increasing the arc power at constant mass flow rate. At constant arc power, thrust efficiency was insensitive to magnetic field strength. The effects of background pressure and magnetic field shape on thruster performance were also studied. By using electrical measurements, such quantities as energy and beam efficiencies, maximum fraction of ionization, and rotating-spoke characteristics were determined. By spectroscopic techniques, the composition of the plasma exhaust, the radial and axial profiles of the spectral lines, and the

axial velocities of the various species in the exhaust were determined. The variation of all these quantities was studied for a range of thruster operating conditions. (auth) (STAR)

51643 RADIATION LOSSES OF A HIGH-DENSITY Z PINCH. Kaufmann, Michael (Institut fuer Plasmaphysik GmbH, Garching, Ger.). Z. Phys.; 225: 216-30(1969). (In German).

The radiative losses of a high density z-pinch ($n_e = 10^{19}$ cm^{-3}) were investigated experimentally. When the compressed column has a temperature of 10 eV, the radiative losses were determined by a special measuring method in which the vacuum uv radiation was resolved in time and recorded by means of an open photocell. This method also involved absolute, but time integrated measurement of the radiation by means of a thermopile. It was possible to achieve a certain resolution of the radiation wavelength by filling a volume between the light source and the detectors with various absorbing gases in succession. It was found that the major part of the internal energy of the plasma was lost by radiation. (auth)

51644 RADIOACTIVITY INDUCED BY PARTICLE ACCELERATION IN AN UNSTABLE LABORATORY PLASMA. Dandl, R. A.; Eason, H. O.; Edmonds, P. H.; England, A. C.; Snell, A. H. (Oak Ridge National Lab., Tenn.). Plasma Phys.; 12: 235-8(Apr 1970).

Acceleration of electrons and ions to walls was observed during plasma instabilities in a hot electron, electron-cyclotron-heated plasma. Radioactivity resulting from (γ,n) reactions with thresholds ~10 MeV demonstrated that electrons are accelerated through several MeV. Radioactivity from ^{13}N resulting from a (d,n) reaction on ^{12}C demonstrated that cold ions are accelerated to at least several hundred keV. (auth) (UK)

51645 RELATION BETWEEN THE SATURATION OF THE METASTABLES AND THE LIMITS OF EXISTENCE OF IONIZATION WAVES IN He, Ne, AND Ar PLASMAS. Pepin, H. (Univ. of Montreal); Drouet, M. G. Phys. Lett.; 33A: 31-2(21 Sep 1970).

Spectroscopic studies of the positive column for conditions near the self-excitation of the ionization waves were performed. The domains of existence of the waves were found to be related to the metastable population for discharge diameters in the range 20 to 150 mm. (auth)

51646 PROPAGATION OF HIGH-FREQUENCY PLASMA. Aubert, M.; Leprince, P. (Faculte des Sciences, Orsay, France). Phys. Lett.; 33A: 7-3(21 Sep 1970). (In French).

An rf discharge is created by exciting the axially symmetric mode of a plasma column; the rf field propagates and ionizes the gas. The plasma density greatly exceeds the critical density. (auth)

51647 RESPONSE OF A WEAKLY IONIZED PLASMA TO TURBULENT GAS FLOW. Garosi, G. A. (Massachusetts Inst. of Tech., Cambridge); Bekefi, G.; Schultz, Michael. Phys. Fluids; 13: 2795-2809(Nov 1970).

An arc discharge struck in a stream of flowing argon gas is studied as the flow is increased from the laminar regime to the regime of fully developed pipe turbulence, with Reynolds numbers (Re) ranging from zero to 6300. The properties of the discharge such as the density and density fluctuations, temperature, and electric field are measured with Langmuir-type probes. The discharge is found to respond strongly to the turbulent fluctuations of the un-ionized background gas. With increasing Reynolds number, plasma density fluctuations go up, the plasma column expands, and certain transport coefficients of the discharge rise well above their classical values. In particular, at Re = 6300, the plasma loss rate exceeds the expected classical value by about an order of magnitude. The observed phenomena can be understood in terms of relatively basic physical models. (auth)

51648 EXPERIMENTAL STUDY OF MAGNETIC FLUX TRANSFER AT THE HYPERBOLIC NEUTRAL POINT. Bratenahl, A.; Yeates, C. M. (California Inst. of Tech., Pasadena). Phys. Fluids; 13: 2696-2709(Nov 1970).

A laboratory study is reported herein of a plasma flow process sometimes referred to as the severing and reconnecting of magnetic field lines at a hyperbolic or X-type neutral point. It is found that a hyperbolic pinch develops at the neutral point resulting in plasma compression. The Ohmic electric field of the pinch current enables field line reconnection to take place through resistive diffusion. The reconnection rate is substantially increased by a reduction in the size of the pinch region effected by flow adjustment through pairs of stationary slow mode shocks in a manner similar to that deduced and described by Petschek. Strong evidence is presented for this wave-dominated co[illegible]nection. However, it is found that the pinch current becomes progressively concentrated at the neutral point and along the shock loci until eventually a critical current density is reached marked by a sudden and large anomalous increase in resistivity as predicted by Friedman and Hamberger. At this point the wave-assisted diffusion mode is terminated and there is observed: (1) a cutoff in pinch current, (2) a large increase in the electric field, (3) corresponding increase in reconnection rate, and (4) generation of a system of large amplitude fast-mode waves. The waves, bearing evidence of the onset of plasma turbulence, effect a rapid and gross redistribution of flux among the cells defined by the separatrix and blow the slow mode shocks off downstream. The increased electric field raises the possibility of rapid magnetic energy dissipation through acceleration of particles to high energy. (auth)

51649 TEMPERATURE DEPENDENCE OF ELECTRIC CONDUCTIVITY OF PULSED DISCHARGE XENON PLASMA. Andreev, S. I.; Gavrilov, V. E. Zh. Tekh. Fiz.; 40: 1300-2(Jun 1970). (In Russian).

The relation between the electric conductivity and temperature of pulsed-discharge plasma in quartz tubes filled with xenon was determined. In the center of the discharge column 7 to 15 mm in diameter at initial pressures of 200 to 600 mm Hg this relationship could be expressed by $\sigma_e = 4.5T_e^6\,\sigma_{mean} + 0.08\,f(T_e)$, where $f(T_e)$ is 2, 4, 8, 20, and 45 at 12, 14, 16, 18 and 20 thousand degrees K, respectively. However, the conductivity and current density relation was ambiguous due to the influence of tube diameter and the time of the discharge. (tr-auth)

51650 RECOMBINATION AND ION-CONVERSION PROCESSES IN HELIUM–NEON MIXTURES. Veatch, G. E.; Oskam, H. J. (Univ. of Minnesota, Minneapolis). Phys. Rev., A; 2: 1422-28(1 Oct 1970).

Detailed studies of the time dependence of the spectral emission and that of the number density of ions were made during the decay period of plasmas produced in helium containing various concentrations of neon atoms. The occurrence of the recombination of Ne^+ via the collisional recombination process with a recombination coefficient proportional to the electron density is established for the first time. The studies confirm the occurrence of recombination processes previously reported for He_2^+ and Ne_2^+. Evidence was also found for the population of the 4d levels of neon by He(2^1S) metastable atoms. New values for the rate constants of the following processes were obtained: $Ne^+ + 2He \rightarrow (HeNe)^+ + He$ (2.1×10^{-32} cm^6 sec^{-1}); $Ne^+ + Ne + He \rightarrow (HeNe)^+ + Ne$ and $Ne_2^+ + He$ (3.0×10^{-31} cm^6 sec^{-1}); $(HeNe)^+ + Ne \rightarrow Ne_2^+ + He$ (3×10^{-11} cm^3 sec^{-1}) – all at a gas temperature of 300°K. (auth)

51651 INFLUENCE OF NONLINEAR EFFECTS ON THE RESONANCE PROPERTIES IN A GAS DISCHARGE PLASMA IN MAGNETIC FIELD. Aref'ev, N. V.; Gil'denburg, V. B.; Markov, G. A. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 305-7(1970). (In Russian).

Nonlinear phenomena appearing in a gas-discharge plasma in the Tonks–Dattner resonances were studied. The latter appear as series of absorption peaks in oscillograms of reflected energy-discharge current in the case in which the discharge tube was inserted into a rectangular waveguide, perpendicularly to the propagation and to the electric field of the incident wave. Data obtained revealed the presence of a longitudinal magnetization of plasma (important for the harmonics of the gyrofrequencies) and nonlinearization of the ionization and temperature. The hysteresis of the resonance curves uncovered the nature of nonlinear processes taking place in plasma. (R.V.J.)

51652 NONEQUILIBRIUM IONIZATION AT THE ENTRANCE OF PLASMA FLOW INTO MAGNETIC FIELDS. Vasil'eva, R. V.; Donskoi, K. V.; Lobasheva, N. M.; Shingarkina, V. A. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz.; 40: 1167-72 (Jun 1970). (In Russian).

Conductance and Hall parameters as functions of magnetic field magnitude and an increase of gas ionization were studied as processes accompanying selective heating of electrons during plasma flow in a magnetic field. The ionizing gas (Ar) flow in a shock tube, a working chamber with annular transverse cross section, and a radial magnetic field were investigated. Inelastic losses, ionization rates, and electron temperatures were found. Data obtained are compared with theoretical results. (tr-auth)

Kinetics (Theoretical)

Refer also to abstract 51683.

51653 (AD-708126) SUPERSONIC EXPANSION FLOW OF AN IONIZED GAS. Igra, O. (Toronto Univ. (Ontario). Inst.

for Aerospace Studies). Mar 1970. 105p. (UTIAS-Review-30; AFOSR-70-765-TR). NTIS.

In a supersonic expansion of an ionized gas, the dominant factor in describing the atomic processes is generally the recombination rate constant K_R. Several models describing the recombination process are reviewed in some detail. It was found that, depending on the adopted definition, different models will yield different values of K_R for the same electron temperature and number density. A comparison between experimental and theoretical values of K_R becomes even more complex, since in the majority of the experiments, K_R is determined from the measured rate of disappearance of free electrons. These measurements give the correct "decay coefficient," but only in certain circumstances will it reduce to the correct value of K_R. (auth) (USGRDR)

51654 (AD-708182) STOCHASTIC PROCESSES AND RELATIVISTIC PLASMA. Final Report, January 1, 1968-May 31, 1970. Kursunoglu, Behram N.; Perlmutter, Arnold (Miami Univ., Coral Gables, Fla. Center for Theoretical Studies). 5 Jun 1970. Contract F44620-68-C-0033. 14p. (AFOSR-70-1645-TR). NTIS.

The research covered by the report is concerned with a number of fundamental aspects of plasma behavior and with some peripheral topics in statistical mechanics and electromagnetic theory. A considerable portion of the effort was based on applications of symmetry approaches from theoretical physics to plasma problems. (auth) (USGRDR)

51655 (AD-708523) COMPUTER SIMULATION OF A SPHERICALLY SYMMETRIC PLASMA. Barnes, Christopher W. (Stanford Univ., Calif. Inst. for Plasma Research). Mar 1970. Contract F44620-69-C-0007. 152p. (SU-IPR-344; AFOSR-70-1006-TR). NTIS.

One-dimensional plasma problems with planar and spherical symmetry are studied by means of numerical simulation techniques. The finite-length planar diode problem with a beam traveling through a neutralizing background of oppositely charged particles is treated and the effect of finite background mass and temperature on beam stability in this model is determined. (auth) (USGRDR)

51656 (CEA-N-1371) PLASMA FLOW AND THE ASSOCIATED MACROSCOPIC EQUATIONS. Guillaneux, Pierre (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). [nd]. 29p. (In French). Dep. NTIS (U. S. Sales Only).

The conditions under which the magnetohydrodynamic equations are valid are specified. A more simple theory predicting the possibility of flow of plasma accompanied by a compression is then studied. This theory is applied to the focused phase of the focus discharge. Under conditions of maximum temperature and density the orders of magnitude calculated were comparable with values deduced using various other methods. (auth) (France)

51657 (IPP-1/106) NUMERICAL CALCULATIONS OF THE DENSITY AND TEMPERATURE VARIATIONS IN CYLINDRICAL PLASMAS PREIONIZED BY UV RADIATION. Keilhacker, M. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). May 1970. 22p. Dep. NTIS (U. S. Sales Only).

To get a picture of the time evolution of density, electron temperature, and ion temperature in cylindrical plasmas preionized by uv radiation, the relevant set of coupled differential equations is solved numerically. The model takes into account energy equipartitioning between electrons and the initially cold ions, radial ambipolar diffusion and heat conduction, and collisional ionization, excitation, and recombination. As an example, numerical results are presented for boundary conditions resembling those of the uv preionization of hydrogen and argon in a large diameter ($2R = 40$ cm) theta pinch. These show that the characteristic times for radial ambipolar diffusion and heat conduction can be made large relative to the energy-equipartition time by superposing an axial magnetic field of the order of 100 gauss. The energy losses due to collisions with the neutral gas reduce the equilibration temperature by roughly 10%. (auth)

51658 (N-70-23950) ANOMALOUS DIFFUSION IN A CYLINDRICAL PLASMA COLUMN ABOVE THE CRITICAL MAGNETIC FIELD. Hu, R. (Michigan Univ., Ann Arbor. Electron Physics Lab.). Feb 1970. 257p. (NASA-CR-109450; TR-115). NTIS. Thesis.

The anomalous diffusion due to the helical instability in a cylindrical plasma column immersed in a strong external axial magnetic field was investigated. Three effects hitherto considered to be negligible in the overall phenomenon are examined in detail, namely: electron inertia, finite-amplitude perturbations, and the motion of ions. The effect of electron inertia on anomalous diffusion is investigated by including this particular term in the electron fluid equations. The transformed equations reveal that the electron inertia does not play an important role in anomalous radial diffusion so long as the electron cyclotron frequency is much larger than the collisional-damping frequency between electrons and neutrals. Nonetheless, the analysis reveals that the electron particle current density in a cylindrical plasma column subjected to an axial static magnetic field is constantly rotating, with some superimposed vibration about the local axis of the external magnetic field. Since the rotation is a local one, it should not be observable. (auth) (STAR)

51659 (N-70-24369) EFFECT OF AN APERTURE ON MEASUREMENT OF THE AXIAL DISTRIBUTION FUNCTION IN A MAGNETICALLY CONFINED PLASMA. Krawec, Roman (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Apr 1970. 42p. (NASA-TN-D-5746; E-5447). NTIS.

Theoretical calculations were performed to determine the distortion in the axial velocity distribution when a magnetically confined plasma passes through an aperture. A general solution is obtained in terms of aperture length to radius ratio, transverse to axial temperature ratio, and normalized length. Results are shown for magnetic field strengths ranging from zero to infinity. It is found that the use of strong magnetic fields allows the aperture to pass a plasma sample from which the true axial distribution function may be obtained. (auth) (STAR)

51660 (NP-18475) MOTION OF INDIVIDUAL PARTICLES IN STELLARATOR-TYPE MAGNETIC CONFIGURATIONS. Delachartre, Monique (Paris Univ. (France). Faculte des Sciences). 10 Jul 1970. 59p. (In French). Dep. NTIS (U. S. Sales Only). Thesis.

The properties of stellarator-type magnetic configurations are described, and a description of the motion of a charged particle in the stellarator field is given. The general equation of motion is not easily integrable. In the case of an adiabatic approximation, i.e., when the magnetic field varies slowly in time and space, an equation describing a mean trajectory of a particle is obtained (the equation of motion of the guiding center). This equation is also difficult to integrate. If the motion of the particle is periodic along the field lines and its drift motion slow, an equation describing the mean trajectory of the guiding center is obtained and the conservation of longitudinal invariance deduced. A study of particle motion in a straight configuration displayed effects which could not be due to curvature. This study indicated the existence of two classes of particles. The conservation of longitudinal invariance was used to study the effect of the curvature on the motion of the particles. Two classes of particles were again distinguished, but it was shown that a sufficiently strong electric field suppressed the separation into two classes. (France)

51661 (NRC-TT-1415) LIGHT MIXING IN FINITE PLASMA VOLUMES. Salat, A. Translated by D. A. Sinclair (National Research Council of Canada, Ottawa, Ont.), from Z. Naturforsch.; 20a: 689-95(1965). 14p. Dep. CFSTI (U. S. Sales Only).

A third-order scattering process of laser light in a fully ionized plasma is considered. Two laser beams may cause the plasma to oscillate with relatively high amplitude if the difference of their frequencies approaches the electron plasma frequency. The light of either one of the beams or of a third beam may be scattered by the induced fluctuations. The plasma is described macroscopically by a cold electron fluid. Special emphasis is given to the finite dimensions of the scattering volume. The results give detailed information about the angular width and intensity of the scattered light. Marked differences in the use of a two and a three laser system are pointed out, the former giving less intensity, the latter being more difficult to realize experimentally. (auth)

51662 FREE ENERGY IN A PLASMA. Chen, Robert L. W. (Emory Univ., Atlanta). Bull. Ga. Acad. Sci.; 28: 125-9(Jun 1970).

By using the H-theorem, an upper bound is derived for the free energy in a plasma. It states that the free energy does not exceed the total energy of a Maxwellian distribution whose entropy is equal to that of the initial distribution. (auth)

51663 EFFECT OF PLASMA INHOMOGENEITY AND DRIFTING PLASMA ON SYNCHROTRON RADIATION FROM MAGNETOPLASMA. Shukla, P. K.; Singh, R. N. (Banaras Hindu Univ., India). Int. J. Electron.; 29: 369-76(Oct 1970).

The synchrotron radiation from relativistic charged particles gyrating along a static magnetic field is affected by the background medium. The author showed the effect of uniform magnetoplasma, the plasma inhomogeneity and the drifting plasma on the synchrotron radiation. The radiated synchrotron power for frequencies $f/f_c \leq 1$ is found to decrease due to the presence of drifting plasma and the synchrotron power in the same frequency range is found to

increase due to the presence of plasma inhomogeneity. For frequencies $f/f_c \geq 1$, the plasma inhomogeneity and drifting plasma show negligible effect. (auth) (UK)

51664 FREQUENCY DEPENDENT TRANSPORT EQUATION FOR A MAGNETOPLASMA. Salat, A.; Joyce, Glenn (Institut fuer Plasmaphysik, Garching, Ger.). Plasma Phys.; 12: 341-59(Apr 1970).

The equation for the pair correlation function from the BBGKY hierarchy was solved for a magnetoplasma under the influence of a weak external force proportional to $\exp(i\omega_1 t)$ using an operator method and a time-periodic ansatz for the one- and two-particle distribution functions. The resulting transport equation is valid for arbitrary frequency ω_1 of a disturbance. The effect of contributions to the kinetic equation from wave–particle resonances is also discussed. (auth) (UK)

51665 ANALYSIS OF D.C. NOISE SPECTRUM IN PLASMA. Nandedkar, D. P.; Bhagavat, G. K. (Indian Inst. of Tech., Bombay). Int. J. Electron.; 29: 329-36(Oct 1970).

In a previous paper (Nandedkar and Bhagavat 1970) a quantum theory of finite dc resistivity of plasma was developed. In the present paper, the effect of ion–molecule collisions on the noise emittance spectrum due to the electrons is considered. It is shown that the resultant noise power due to the electrons and the ions constituting the spectrum of electromagnetic radiations cancels out everywhere in the space. (auth) (UK)

51666 LAMINAR ELECTROSTATIC SHOCK WAVES IN A PLASMA. Bardotti, G.; Segre, S. E. (CNEN, Rome). Plasma Phys.; 12: 247-52(Apr 1970).

Solutions of Poisson's equation are found that correspond to steady plane electrostatic disturbances propagating in a plasma where the electrons are in equilibrium at a temperature T_e with the potential and the ions, with a finite temperature T_i, are collision-free. These solutions are shock-like transitions of potential (propagating at a constant velocity) from a uniform initial state to a final state which, in general, is oscillatory but is found to be uniform for strong shocks. (auth) (UK)

51667 RADIAL DEPENDENCE OF THE ENERGY LOSS DUE TO POTASSIUM RESONANCE RADIATION IN AN INFINITELY LONG PLASMA CYLINDER. Dodel, G. (Institut fuer Plasmaphysik, Munich). Plasma Phys.; 12: 265-71(Apr 1970).

The radial dependence of the energy loss due to potassium resonance radiation is calculated for an infinitely long argon–potassium plasma cylinder. The calculations are made by means of an approximation method for integrals by Gauss. Both a homogeneous cylinder model and a cylinder model with an assumed radial electron temperature profile are calculated. (auth) (UK)

51668 INFLUENCE OF HEAVY-PARTICLE COLLISIONS ON POPULATION AND IONIZATION EQUILIBRIUM IN WEAKLY IONIZED PLASMA. Suckewer, S. Phys. Lett.; 32A: 507-8 (7 Sep 1970).

Formulas are given for defining the population and degree of ionization of atoms in optically thin plasma, taking into consideration collisions of atoms and ions with heavy particles (atoms, molecules) in addition to those with electrons. (auth)

51669 PLASMA–AIR JUNCTION PROBLEM IN PARALLEL-PLATE WAVEGUIDE. Hurd, R. A. (National Research Council, Ottawa). Int. J. Electron.; 29: 217-31(Sep 1970).

The discontinuity admittance of an air–plasma interface in parallel-plate waveguide is computed using quasi-static approximations and by solving a singular integral equation. The plasma is gyrotropic, with the polarizing magnetic field applied parallel to the air–plasma edge. As had been predicted earlier, two ranges of "intrinsic loss" are found. A justification for the correctness of intrinsic loss is included; this includes a demonstration that a limit Hermitian permeability or permittivity tensor does not necessarily imply zero loss in the medium. (auth) (UK)

51670 STABILITY OF TRANSVERSE WAVES IN A RELATIVISTIC PLASMA. Gupta, R. M. (Univ. of Rajasthan, Jaipur, India). Phys. Lett.; 32A: 464-5(7 Sep 1970).

The dispersion relation for transverse wave mode in a relativistic plasma has been obtained as

$$-\frac{q^2}{\epsilon_0(\omega^2 - c^2k^2)} \sum_{n=-\infty}^{\infty} \int \left[(n\Omega - \omega)p_\perp \left(\frac{\partial f_0}{\partial p_\perp}\right) - \frac{n\Omega}{p_\perp} p_\perp^2 \left(\frac{\partial f_0}{\partial p_\perp}\right)\right] \times \frac{J_n^2(kp_\perp/\gamma m\Omega)}{(n\Omega - \omega)} dp = 1$$

where $\Omega = eB_0/\gamma mc$ is the relativistic cyclotron frequency and the other symbols have the usual meaning. The above relation has been derived by assuming k, the wave vector in x–z plane and the static magnetic field B_0 in z-direction. The case is considered when $kp_\perp/\gamma m\Omega \ll 1$, which indicates that the wavelength of electrons is much larger than the gyroradius. (M.O.W.)

51671 COLLISION FREQUENCIES OF NEUTRAL PARTICLES IN HYDROGEN AND ARGON PLASMAS. Appert, K. (Univ., Fribourg, Switzerland). Phys. Lett.; 32A: 477-8(7 Sep 1970). (In German).

Electron–atom, ion–atom, and atom–atom collision frequencies are calculated in the temperature range 0.1 to 10 eV. The diffusion cross sections used are taken from both experimental and theoretical sources. (auth)

51672 GENERALIZATION OF THE SHEATH CRITERION IN AN ANISOTROPIC PLASMA. Andrews, J. G. (Central Electricity Generating Board, Southampton, Eng.); Stangeby, P. G. J. Phys., A (London); 3: L39-40(Sep 1970).

Stangeby and Allen (1970) have demonstrated that the plasma–sheath boundary is a Mach surface in a collisionless plasma containing an anisotropic cold ion velocity distribution and no ionization. It is shown that the plasma–sheath boundary is still a Mach surface even when the effects of ionization, momentum-transferring collisions, and a finite ion temperature are considered. (auth) (UK)

51673 DEPENDENCE OF ANOMALOUS CONDUCTIVITY OF PLASMA ON THE TURBULENT SPECTRUM. Hamberger, S. M.; Jancarik, J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Phys. Rev. Lett.; 25: 999-1002(12 Oct 1970).

The scaling laws for "anomalous" conductivity seen in a turbulent plasma are shown to depend on the type of electrostatic fluctuation spectrum present, which in turn depends on the relative drift velocity between ions and electrons. (auth)

51674 SIMILARITY ARGUMENTS FOR HIGH-FIELD ELECTRICAL CONDUCTIVITY IN A PLASMA. O'Neil, T. M. (Univ. of California, San Diego, La Jolla). Contract AT(04-3)-34 PA85-13. Phys. Rev. Lett.; 25: 995-6(12 Oct 1970).

Similarity arguments are used to show that the dc electrical conductivity of a plasma is independent of the field, for a large enough field, even though the conductivity is completely determined by turbulence processes. (auth)

51675 TRANSPORT PROPERTIES OF A PLASMA IN A STRONG MAGNETIC FIELD. Gilbert, B. J.; Radin, S. (Lehigh Univ., Bethlehem, Pa.). Phys. Fluids; 13: 2693-5 (Nov 1970).

The longitudinal electrical and thermal conductivities of a fully ionized plasma in a strong external magnetic field are calculated. The magnetic field is strong enough to significantly affect the collision process, but it is not so strong as to dominate. (auth)

51676 RELAXATION PROCESSES IN PLASMAS WITH MAGNETIC FIELD. TEMPERATURE RELAXATIONS. Ichimaru, Setsuo; Rosenbluth, Marshall N. (Inst. for Advanced Study, Princeton, N. J.). Phys. Fluids; 13: 2778-89(Nov 1970).

The Fokker–Planck coefficients of a plasma in the magnetic field are calculated in terms of the spectral function of the electric-field fluctuations and the dielectric response function; the results are used for the investigation of temperature relaxation processes. It is found that the relaxation rate between the electron and ion temperatures contains, in addition to the usual Spitzer rate, an anomalous term which diverges logarithmically as the mass ratio approaches zero. The physical origin of this anomalous term is the strong coupling between the spiral motion of the electrons and the long-wavelength, low-frequency fluctuations produced by the ions; its magnitude can become comparable to the Spitzer rate for a strong magnetic field. In the case of the temperature relaxation between the parallel and perpendicular directions to the magnetic field, the screened Coulomb interaction provides the major relaxation mechanism; the effects of the fluctuations associated with the Bernstein modes are negligibly small. (auth)

51677 CONDUCTIVITY OF A WEAKLY IONIZED PLASMA AS RELATED TO PARTICLE DIFFUSION IN μ SPACE. Hagfors, T. (Massachusetts Inst. of Tech., Lexington). Phys. Fluids; 13: 2790-4(Nov 1970).

A method is developed whereby the conductivity tensor of a collision-dominated plasma is expressed in terms of the correlation function for microcurrents as in the case of a collisionless plasma. When collisions are important, the motion of particles through phase space must be considered as a stochastic, diffusionlike process rather than as a dynamical one as in the collisionless plasma. Some examples of the diffusion process are considered and the resulting conductivity is related to previous work. (auth)

51678 COMPUTATIONS ON ANOMALOUS RESISTANCE. Boris, J. P. (Princeton Univ., N. J.); Dawson, J. M.; Orens,

J. H.; Roberts, K. V. Contracts AT(30-1)-1238; N00014-67-A-0151-0021. Phys. Rev. Lett.; 25: 706-10(14 Sep 1970).

Results of computer simulations of electrostatic "anomalous resistivity" are reported. One- and two-dimensional plasma simulations were performed in which an external (nonself-consistent) spatially constant electric field was imposed to drive a current in the plasma. In these calculations the electron distribution is subject to collective runaway with beaming and thermal energy increasing about equally. (auth)

51679 TRANSPORT COEFFICIENTS FOR A MULTICOMPONENT MIXTURE OF IONIZED GASES. Kumar, K. (Australian National Univ., Canberra). Aust. J. Phys.; 23: 505-20(Aug 1970).

Formulas are derived for all the transport coefficients in a multicomponent mixture of ionized gases in the second Chapman–Enskog approximation, for arbitrary orders in Sonine polynomial expansion. The field-free case, which is equivalent to the case of a neutral mixture, is treated first in detail and the modifications needed to include the effects of a weak electric field are indicated. In the presence of a strong magnetic field the transport coefficients become field-dependent in a significant way; corresponding formulas are given. (It is assumed that the long-range collective effects due to Coulomb forces are either unimportant or can be taken into account by modifying the intermolecular interactions.) A new treatment of the redundancy problem is given. The transport coefficients are expressed in terms of an inverse matrix. Complete formulas for the matrices to be inverted are given, and the procedure for their use in actual computation is discussed. (auth) (Australia)

51680 SIMPLE DERIVATION OF THE FINITE-WAVELENGTH, HIGH-FREQUENCY DIELECTRIC CONSTANT OF A CLASSICAL COULOMB PLASMA. Baus, M.; Dasgupta, B. (Univ. of Brussels). Bull. Cl. Sci., Acad. Roy. Belg.; 56: 53-62(1970).

The lowest order collisional contribution to the frequency and wave vector dependent dielectric constant of a classical plasma is obtained through a simple diagram summation similar to the well known summation leading to the Vlasov polarizability. The connection with the infinite wavelength results is explicitly given. (auth)

51681 MODEL INTEGRALS FOR COLLISIONS AND OSCILLATIONS IN THREE-COMPONENT PLASMA. Stepanov, A. S.; Al'terkop, B. A. Zh. Tekh. Fiz.; 40: 1150-8(Jun 1970). (In Russian).

An integral model is developed for collisions of various-mass particles in a multicomponent mixture. The model is in agreement with the law of conservation for the number of particles, pulses, and energy, and describes accurately the relaxation of pulses and energy for the multiple components in the mixture. The model is used in studies of the parallel oscillations in partially ionized plasma. The dispersion equation is resolved for various ratios between oscillation and collision frequencies. The frequency and decrement of sonic, ionosonic, and Langmuir oscillation attenuation in three-component plasma are determined for isothermal and nonisothermal cases. Strong attenuation, due to collision branches of oscillations was found, and the influence of electrons on low-frequency oscillations is estimated. (tr-auth)

51682 MASS-TRANSFER PROCESSES DURING ELECTRODYNAMIC PLASMA ACCELERATION. Kolesnikov, P. M.; Stolovich, N. N. (Inst. of Heat- and Mass Transfer, Minsk). Zh. Tekh. Fiz.; 40: 1194-1201(Jun 1970). (In Russian).

The mass-transfer processes induced by plasma recombinations and diffusion, electrode erosion, and recharge are studied. The total energy balance and acceleration efficiency are analyzed, considering the above processes. (tr-auth)

Production

Refer also to abstracts 51470, 51477, and 51602.

51683 (EUR-CEA-FC-548) INTERACTION OF A LASER-PRODUCED PLASMA WITH A UNIFORM MAGNETIC FIELD. Bayard, J. P.; Boujot, J. P.; Mattioli, M.; Soule, J. L. (European Atomic Energy Community. Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jul 1970. 20p. Dep. NTIS (U. S. Sales Only).

The interaction of a laser-produced plasma with a uniform magnetic field is treated numerically; the plasma motion is described by a one-fluid model, the geometry has cylindrical symmetry and axial losses are taken into account. Numerical computations were performed for plasmas having initial parameters similar to those obtained experimentally with LiH pellets. The results are compared with previously published computations and experimental results. (tr-auth) (France)

51684 (IPP-1/99) PREIONIZATION FOR COLLISIONLESS SHOCK WAVE EXPERIMENTS BY MEANS OF PHOTOIONIZATION. Keilhacker, M.; Pecorella, F.; Vlases, G. C. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Dec 1969. 50p. Dep. NTIS (U. S. Sales Only).

Strong ultraviolet radiation emitted from a dynamically filled linear z pinch in xenon is used to ionize low-density molecular hydrogen and the noble gases. The technique can be used to produce an initial plasma with electron densities of 10^{12} to 10^{14} cm^{-3} suitable for collisionless shock-wave experiments. The degree of ionization that can be achieved at the center of a 150-cm-long test chamber having one light source at each end ranges at 1 mtorr filling pressure from 20% in H_2 to 63% in xenon. The plasma is relatively homogeneous, current- and impurity-free, and has an electron temperature of about 1 eV. To get a picture of the space–time dependence of density, electron temperature, and ion temperature in the photoionized gas, the relevant set of coupled differential equations is solved numerically. The calculations show that for conditions resembling those of the experiment the energy equipartition time between electrons and ions can be made shorter than the times for radial diffusion and heat conduction by superimposing an axial magnetic field on the order of 100 gauss. (auth)

51685 INTERACTIONS BETWEEN A LASER BEAM AND A SOLID TARGET. Bobin, J. L. (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). Onde Elec.; 50: 577-81 (Jul-Aug 1970). (In French).

The temperature and density of a plasma heated by a laser beam were calculated when the light was absorbed in internal bremsstrahlung. The highest temperatures were obtained when the plasma density reached the cutoff value. The temperatures were proportional to the $^2/_3$ power of the laser flux. (tr-auth) (France)

51686 PRODUCTION OF HIGH FLUXES OF PHOTONS: UTILIZATION AND FOCUSING OF HIGH POWER LASERS. de Metz, J. (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). Onde Elec.; 50: 572-6(Jul-Aug 1970). (In French).

High-power neodymium lasers were developed. The focusing of the beam on a solid deuterium target was improved by using aspherical lenses. (tr-auth) (France)

51687 TWO-PHOTON IONIZATION OF CESIUM AND SODIUM VAPORS. Kishi, Kumeyo (Nagoya Univ., Japan); Sawada, Katsutoshi; Okuda, Takayoshi; Matsuoka, Yoshiharu. J. Phys. Soc. Jap.; 29: 1053-61(Oct 1970).

The breakdown and the growth of plasma of cesium and sodium vapors by an intense laser beam are investigated. The minimum intensity observable by a double probe is found to be inversely proportional to the root of the neutral atom density for either vapor. This result confirms that the two-photon ionization is a dominant process in the stage of breakdown. Further increase of the laser beam intensity leads to a steep rise of the plasma density proportional to the square of the intensity followed by a slow rise and then the second steep rise. The first steep rise is explained by the two-photon ionization process too. The electron temperatures are estimated to be about 10^4°K by probe and optical methods. (auth)

51688 ULTRA-VIOLET EMISSION FROM A PLASMA PRODUCED BY FOCUSING A LASER BEAM ON A SOLID TARGET. Schwob, J. L.; Breton, C.; Seka, W.; Minier, C. (CEN, Fontenay-aux-Roses, France). Plasma Phys.; 12: 217-25(Apr 1970). (In French).

The radiation spectrum of a plasma produced by laser impact on a solid Al target was observed as a function of time in the wavelength region between 50 and 2000 Å. This spectrum consists of an intense continuum background along with line radiation of ions of high degree of ionization. The electron temperature was determined from the maximum of the bremsstrahlung continuum after a careful analysis of the contributions of the different orders of the diffraction grating as well as an intensity calibration of the uv spectrometer. (auth) (UK)

51689 IONIZATION IN A LASER-PRODUCED PLASMA. Green, T. S. (European Space Research Inst., Frascati, Italy). Phys. Lett.; 32A: 530-1(7 Sep 1970).

Energy absorption, expansion, and ionization processes taking place in a laser-irradiated solid are studied theoretically. Relatively long laser pulses are considered. (M.O.W.)

51690 FORMATION AND HEATING OF LASER IRRADIATED SOLID PARTICLE PLASMAS. Haught, Alan F.; Polk, Donald H.

(United Aircraft Research Labs., East Hartford, Conn.). Phys. Fluids; 13: 2825-41(Nov 1970).

High-energy, spherically symmetric, free plasmas are produced by electrically suspending a small solid, lithium hydride particle in a vacuum at the focus of a lens where the particle is vaporized, ionized, and the resulting plasma heated by the focused beam of a Q-spoiled laser. A two-temperature, integrated similarity model was developed for calculation of the plasma time development and gives plasma energies in good agreement with those determined experimentally. Charge collector and expansion velocity measurements show that the plasma expansion is spherically symmetric with a linear velocity profile as assumed in the calculations. While line radiation studies indicate that some recombination occurs in the plasma from mass spectrometer measurements, the plasma consists primarily of Li^{3+} and H^{+} for plasma energies above 100 eV. Calculations are carried out to define the optimum conditions of particle radius, focal spot size, pulse duration, and laser peak power for both maximum plasma energy and maximum plasma quantity at a given energy. Based on the results of these calculations, average plasma energies in excess of 5 keV can be produced with 10-J, 0.1-nsec laser pulses, and a laser system with these characteristics is being developed for high-energy plasma production experiments. (auth)

51691 ESTABLISHMENT OF HARMONIC FREQUENCIES IN A PENNING-TYPE DISCHARGE. Shipley, Elwood D.; Yonts, Oliver C. (to United States Atomic Energy Commission). U. S. Patent 3,528,034. 8 Sep 1970. Filed 26 Jul 1968.

One cathode of a Penning-type discharge device is divided in half with a resonant circuit joining the two parts. The plasma discharge therein, which otherwise contains a continuum of frequencies, is thereby modified so as to contain only harmonic frequencies, thereby substantially stabilizing the plasma. Such a device may also be used, if desired, as a simple frequency-modulated broadcasting unit by the application of an audio-range frequency to the voltage on the anode of the device. (auth)

51692 PRODUCTION AND UTILIZATION OF HIGH-DENSITY PLASMA. Bennett, Willard H. U. S. Patent 3,526,575. 1 Sep 1970. Filed 2 Aug 1967.

Apparatus is described for producing pulsed beams of relativistic electrons which, by means of linear pinch techniques, are focused down to less than 2-mm diameter and preferably less than 1 mm, thereby making possible the generation of an extremely high power density on a selected target. Apparatus is also considered that provides for the impingement of such beams of high power density upon targets adapted to make possible the production of thermonuclear fusion power and the production of transuranic elements in more than microgram quantities. (auth)

51693 FORMATION OF SHORT PLASMA CLUSTERS BY A PULSED MULTIPOLE MAGNETIC FIELD. Demidenko, I. I.; Lomino, N. S.; Padalka, V. G. Zh. Tekh. Fiz.; 40: 1217-23 (Jun 1970). (In Russian).

The possibility of using pulsed magnetic fields created by a linear quadrupole system was studied in order to produce short plasma clusters. The spatial separation of hydrogen and impurity ions in the plasma jet generated in the source played an important role in the process. The switching on of the pulsed multipole magnetic field was achieved at various time intervals corresponding to various positions of the plasma flux in relation to the magnetic system. The leading portion of the flux passing the system before its switching on does not alter its properties. After switching on the magnetic field, the slow cold section of the stream is captured due to the development of polarization and spreading of the plasma captured along the multipole magnetic system. (tr-auth)

Stability

Refer also to abstract 51691.

51694 (IPP-1/105) EXPERIMENTAL PROOF OF MIRROR INSTABILITIES IN THE THETA-PINCH ISAR I. Kaufmann, M.; Neuhauser, J.; Roehr, H. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Feb 1970. 39p. (In German). Dep. CFSTI (U.S. Sales Only).

In the "ISAR I" linear theta pinch m = 0 instabilities were observed and experimentally investigated. The variation of the plasma parameters over a wide range ($\tau_{ii} = 10^{-2} \ldots 10^{2}$ μs) showed that the m = 0 instabilities only occurred in sufficiently hot and thin plasmas, and so they are most probably due to the anisotropic pressure of the ions and should be mirror instabilities. Perturbations of the plasma limited in space and time were observed by measurement of the continuum radiation, 90° laser scattering, measurement of the magnetic field, and by measurement of the local neutron rate. All measurements showed distinct, correlated, local perturbations of the plasma cylinder. Such perturbations were accompanied by bulging of the plasma cylinder and increasing density. The extension in the axial direction was of the order of the plasma diameter. It may be assumed that the observed instabilities contribute appreciably to the relaxation of the anisotropic ion pressure and increase the end losses. (auth)

51695 (IPP-6/86) THE STABILITY OF STEADY FINITE AMPLITUDE CONVECTION IN A ROTATING FLUID LAYER. Kueppers, Guenther (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Apr 1970. 22p. Dep. CFSTI (U. S. Sales Only).

The stability of finite-amplitude convective flow in an infinite, horizontal fluid layer rotating rigidly about a normal axis is investigated for the case of rigid boundary conditions and finite Prandtl numbers. Solutions of the nonlinear steady-state equations are derived approximately by an amplitude expansion. It can be shown by a stability calculation that all three-dimensional solutions are unstable and, furthermore, for a given value of the Prandtl number there exists a critical value of the Taylor number above which the only stable two-dimensional rolls become unstable, too. This means there is a transition from pure heat conduction to time-dependent convective flow. (auth)

51696 EFFECTS OF A HIGH-FREQUENCY ELECTRIC FIELD ON MICROINSTABILITIES DRIVEN BY DENSITY GRADIENT. Okamoto, Masao (Kyoto Univ.); Amano, Tsuneo; Kitao, Kazuo. J. Phys. Soc. Jap.; 29: 1041-53(Oct 1970).

Drift, drift-dissipative, and drift-cyclotron instabilities in an inhomogeneous plasma are considered for the case when a uniform high-frequency electric field is applied along the magnetic field. For the applied field, the dipole approximation is made and the skin effect is neglected. Without averaging the distribution function over the period of the applied electric field, the dispersion relations are derived for both the collisionless and collisional regimes. It is found that the high-frequency field whose frequency is within some ranges increasing the frequencies of perturbations can stabilize drift instabilities and also drift-cyclotron instabilities with finite k_z of the fluid-type, where k_z is the component of the wave vector along the magnetic field. It is found, however, that when the unstable drift-dissipative mode is stabilized, the stable mode becomes unstable. (auth)

51697 MINIMUM-$\bar{B}$ STABILIZATION OF DRIFT WAVES IN A Q MACHINE. Chen, Francis F.; Rogers, Kenneth C. (Princeton Univ., N. J.). Plasma Phys.; 12: 253-64(Apr 1970).

A minimum-$\bar{B}$ geometry is created in a Q machine by inserting reverse-current loops into the vacuum chamber. The level of drift oscillations, both coherent and turbulent, is found to be greatly reduced when the loops are energized. (auth) (UK)

51698 EQUILIBRIUM AND STABILITY OF A SHARP-SURFACE STELLARATOR WITH A LONGITUDINAL CURRENT. Weimer, Katherine E.; Greene, John M.; Johnson, John L. (Princeton Univ., N. J.). Plasma Phys.; 12: 227-34(Apr 1970).

Earlier results on stellarators with sharp plasma surfaces are extended to include the case with a current parallel to the magnetic field. A previous theorem that the equilibrium shift becomes infinite and changes signs at marginal stability is generalized. A configuration with constant rotational transform outside the plasma is shown to have properties favorable to stabilization of the kink mode. (auth) (UK)

51699 ABSOLUTE AND CONVECTIVE PLASMA MICROINSTABILITIES. McCune, J. E.; Callen, J. D. (Massachusetts Inst. of Tech., Cambridge). Plasma Phys.; 12: 305-30(Apr 1970).

A general criterion for electrostatic instability of either the convective or absolute type in a weakly inhomogeneous, hot magnetoplasma (slab model) is given in a form that makes convenient the determination of the density and frequency for onset of instability for any k. A new and very efficient method for implementing the Bers–Briggs criterion for appearance of absolute instability is developed. This technique not only utilizes the fact that the density is a "free parameter" in the dispersion relation, but also makes maximum use of information already available from marginal stability analysis to significantly reduce the task of locating true absolute-instability modes. The method is applied to the loss-cone instability; it is shown that this instability always becomes absolute at sufficiently high densities for finite k. (auth)

51700 COMPUTER EXPERIMENTS ON SHEET PINCH STABILITY. Burn, Robert D. (Stanford Univ., Calif.). Plasma Phys.; 12: 331-9(Apr 1970).

Three computer models simulating the motion of a plasma in both one and two dimensions were applied to the sheet or planar pinch. Both the relativistic regime, including retardation effects, and the nonrelativistic regime were investigated. In all cases

both electric and magnetic interactions were allowed. The sheet pinch was completely stable both to spreading and fast wave instabilities, but exhibited tearing-mode instabilities in the slow-wave regime. Typically, the tearing consisted of an initial break-up into multiple strands, which subsequently underwent coalescence. (auth) (UK)

51701 INSTABILITY OF THE POSITIVE COLUMN OF FINITE LENGTH IN A MAGNETIC FIELD. Janzen, G.; Moser, F.; Raeuchle, E. (Univ., Stuttgart). Z. Naturforsch.; 25a: 992-1006(Jul 1970).

The instability of a diffusion-dominated positive column of a gas discharge in a longitudinal magnetic field is investigated both experimentally and theoretically. Dispersion relations are derived for the case of an m = 1 helical instability, considering the finite length of the column. Regions of instability are calculated for various wavelengths of the instability. Experiments were carried out in a positive column of variable length, ranging from 8.5 to 40 cm, at varying pressures of about 0.1 torr of neon. There is a satisfactory agreement between theory and experiments. The main results are: (a) in long tubes instability occurs at a distinct magnetic field, calculated first by Kadomtsev and Nedospasov; stable intermediate regions are possible at higher fields depending on the relations between the plasma parameters; (b) in short tubes the column is stable again for higher magnetic fields; and (c) in very short tubes there is no instability of this kind. The observed frequency spectrum agrees with the theoretical values. (auth)

51702 TRANSVERSE INSTABILITIES IN STEAMING COLLISIONAL PLASMAS. Buti, B.; Lakhina, G. S. (Indian Inst. of Tech., New Delhi). Phys. Lett.; 32A: 518-19(7 Sep 1970).

Coulomb collisions are found to stabilize the system comprised of contrastreaming plasmas by increasing the value of the streaming velocity required to excite the transverse instability in these plasmas. (auth)

51703 ELECTROMAGNETIC TRAPPED-PARTICLE MODES IN MULTIPOLES. Bussac, M. N.; Laval, G.; Pellat, R. (CEA-CEN, Fontenay-aux-Roses, France). Phys. Lett.; 32A: 491-2 (7 Sep 1970).

The effect of a finite plasma pressure on the trapped-particle instability is discussed, and it is shown that the critical β may be more severe than the usual ballooning limit. (auth)

51704 DRIFT WAVES AND PLASMA DIFFUSION IN A SHEAR-STABILIZED Q MACHINE. Stott, P. E.; Little, P. F.; Burt, J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Phys. Rev. Lett.; 25: 996-9(12 Oct 1970).

The effects of magnetic shear on unstable drift waves are studied in a straight l = 3 stellarator. Increasing the shear reduces the amplitude of the instability and also the cross-field diffusion coefficient. (auth)

51705 STABILITY OF A BULGED THETA PINCH. Bodin, H. A. B.; Newton, A. A.; Wolf, G. H.; Wesson, J. A. (Culham Lab., Abingdon, Eng.). Phys. Fluids; 13: 2735-46(Nov 1970).

An experimental and theoretical study was made of the hydromagnetic instability of an axisymmetric bulged region in the midplane of a theta pinch 8 m long. The bulged region was generated adiabatically after the initial implosion in such a way that it fulfilled most of the assumptions of the theoretical model; in particular, it was free of end effects for the time of observation. At a filling pressure of 20 mtorr D_2 and with a peak magnetic field of 20 kG the plasma, which was collision-dominated, had values of temperature, density, and beta on the axis of 120 eV, 3×10^{16} cm^{-3}, and 0.7 ± 0.2. The predicted m = 1 instability was observed and for a range of bulge amplitudes its measured growth and propagation along the column agreed to within a factor of less than 2 with the theoretical values. It is concluded that the m = 1 instability of such bulged plasmas is well described by ideal hydromagnetic theory. Modes with m $\geq$ 2 were not observed during the m = 1 growth and their absence is attributed to finite Larmor radius stabilization. (auth)

51706 SIDEBAND INSTABILITY. Kruer, W. L.; Dawson, J. M. (Princeton Univ., N. J.). Phys. Fluids; 13: 2747-51 (Nov 1970).

Computer experiments on one-dimensional sheet plasmas show that large amplitude electron plasma oscillations with trapped particles can be unstable. This behavior is consistent with both a recent experiment and a recent theory predicting a trapped-particle instability. (auth)

51707 LOW DENSITY CYCLOTRON INSTABILITY IN A TWO-COMPONENT ELECTRON PLASMA. Blanken, R. A. (Oak Ridge National Lab., Tenn. Massachusetts Inst. of Tech., Cambridge); Lazar, N. H. Phys. Fluids; 13: 2752-6(Nov 1970).

A velocity space instability with frequency near the electron cyclotron frequency f_c was observed in a hot electron plasma. Measurements of the frequency shift above f_c, the stability boundary and the growth rate agree well with calculations for the two-component instability. (auth)

51708 NONLINEAR THEORY OF THE DRIFT-DISSIPATIVE INSTABILITY. Sleeper, Arthur M.; Simon, Albert (Univ. of Rochester, N. Y.). Phys. Fluids; 13: 2757-65(Nov 1970).

The drift instability of a weakly ionized plasma is analyzed in a semi-infinite slab geometry. Analytic expressions are obtained for the unstable eigenmodes and all critical linear parameters. By choosing the appropriate operating regime (in terms of background pressure and applied magnetic field), it is possible for only one mode to go unstable as the pressure decreases by an appreciable amount below the critical value. Nonlinear theory is then used to solve for the saturated mode amplitude and frequency shift as functions of the fractional decrease in pressure. The anomalous flux is also obtained. One interesting result is that the frequency shift is very small for this instability. (auth)

51709 ROTOR EQUILIBRIA OF NON-NEUTRAL PLASMAS. Bogema, Bernard L. Jr. (Univ. of Maryland, College Park); Davidson, Ronald C. Phys. Fluids; 13: 2772-8(Nov 1970).

Equilibria are considered within a Vlasov–Maxwell model for an electron gas column rotating about an axis parallel to a uniform external magnetic field B_0. A condition is derived that restricts the values of ω_R (angular speed of mean rotation), Ω_c (electron cyclotron frequency), and ω_p (electron plasma frequency on axis) in order that the general class of rigid-rotor distributions $f^0(H_\perp - \omega_R L, p_z)$ corresponds to radially confined equilibria in the nonrelativistic, nondiamagnetic case. It is demonstrated that rigid-rotor distributions have the property that a specification of the radial equilibrium density profile $n^0(r)$ uniquely determines the distribution $\int dp_z f^0(H_\perp - \omega_R L, p_z)$ of electrons perpendicular to B_0. Explicit examples in this regard are discussed in both the nonrelativistic, and relativistic, diamagnetic cases. This can serve as a useful experimental diagnostic whereby a determination of $n^0(r)$ yields the perpendicular distribution $\int dp_z f^0(H_\perp - \omega_R L, p_z)$. (auth)

Thermonuclear Processes

51710 (EUR-CEA-FC-554) MAGNETIC CONFIGURATION IN A CIRCULAR QUADRUPOLAR WELL: DECA II B. Lecoustey, P.; Tachon, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Aug 1970. 35p. (In French). Dep. NTIS.

The plasma confinement equipment of Deca II B is described. A method of focusing the magnetic lines outside the confinement zone by placing on each side of the quadrupolar field, which ensures plasma stability, two other quadrupolar coils in opposition with the first ones, was sought. This method was called circularization. The object of the experiment was to study the confinement of a relatively dense plasma when charge-exchange losses are not dominant. (tr-auth) (France)

51711 (IPP-1/107) NEUTRON YIELDS AND ENERGY SPECTRA FOR HOT DEUTERIUM–TRITIUM PLASMAS. Lehner, G.; Pohl, F. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Mar 1970. 21p. Dep. CFSTI (U. S. Sales Only).

The use of deuterium–tritium instead of deuterium plasmas would allow neutron diagnostics to be improved because the neutron production rate would then be appreciably larger (by a factor of approximately 100). Neutron production rates and energy spectra are given for various velocity distributions of the deuterons and tritons in a hot plasma. (auth)

51712 (IPP-6/83) ASYMPTOTIC MAGNETIC SURFACES. Spies, Guenther Otto; Lortz, Dietrich (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Dec 1969. 39p. Dep. CFSTI (U. S. Sales Only).

Toroidal magnetic fields $B = \Sigma_{\nu \geq 0} E^\nu B_\nu$ where the unperturbed field B_0 has closed lines of force are considered. On rather weak assumptions it is shown that single-valued formal solutions $F = \Sigma_{\nu \geq 0} E^\nu F_\nu$ of the equation $B \cdot \nabla F = 0$ exist, and that the asymptotic magnetic surfaces F = const are uniquely determined up to any order. Recursion formulas are derived that allow calculation of any order of F from its lower orders, and explicit expressions are given for F_0 that depend on whether the rotational transform is of the same or of higher order than the perturbing field. For the special cases of stellarator-like vacuum fields a necessary condition is derived for the asymptotic magnetic surfaces to be

toroidally closed. As another application the lowest order of an adiabatic invariant is constructed for the longitudinal guiding-center motion. (auth)

51713 (LA-4469) HIGH-VOLTAGE TEST OF A LARGE CRYOGENIC COIL FOR MAGNETIC ENERGY STORAGE SYSTEM. Lady, E. R.; Call, D. L.; Bronson, J. C. (Los Alamos Scientific Lab., N. Mex.). Jun 1970. Contract W-7405-eng-36. 10p. Dep. NTIS.

The 1-MJ aluminum coil designed and fabricated by the National Bureau of Standards, Boulder, Colorado, was tested at the Los Alamos Scientific Laboratory when warm and when immersed in liquid nitrogen and liquid hydrogen. The coil was energized by a 10-kV, 100-kJ capacitor bank that was crowbarred at the first current maximum. This report describes the coil, cryogenic system, and charging network and demonstrates the feasibility of using a pulsed magnetic energy storage coil immersed in liquid hydrogen. Test results are included. (auth)

51714 LASER AND THERMONUCLEAR FUSION. Tonon, G. (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). Onde Elec.; 50: 590-8(Jul-Aug 1970). (In French).

The conditions required for the breakeven to be reached in a plasma produced by a laser beam were determined. The product $n\tau$ (n plasma density and τ = heating time) had to reach a minimum value and this value was obtained for a plasma density of about 10^{20} ions/m^3 and a heating time of a few nanoseconds. The free expansion of the plasma was taken into account when studying the interaction of a laser beam with a solid target. (tr-auth) (France)

51715 NUCLEAR FUSION REACTIONS CREATED BY A LASER BEAM. Delobeau, F. (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). Onde Elec.; 50: 569-71 (Jul-Aug 1970). (In French).

The development of giant pulsed glass lasers gave rise to new possibilities in high-density and high-temperature plasma physics. Very high temperatures were obtained in solid deuterium plasmas produced by a laser beam. When the shape of the laser pulse was adapted to the plasma flow hydrodynamics, the energy absorbed was high enough for some D–D nuclear reactions to take place in the plasma. Up to 10^4 neutrons were emitted during these experiments. (tr-auth) (France)

51716 NUCLEAR FUSION REACTIONS OBTAINED BY A LASER BEAM. Floux, F. (Centre d'Etudes de Limeil, Villeneuve-Saint-George, France). Onde Elec.; 50: 582-9 (Jul-Aug 1970). (In French).

By inserting a Pockels cell into the amplifier cascade of a Q-switched Nd glass laser, a laser pulse of 7 to 8 nsec was obtained. The energy used did not exceed 40 J and the maximum power was about 4 GW. The laser beam was focused on a deuterium solid target by a special aspherical lens. Many of these experiments were carried out, and signals obtained in detectors were shown to come from neutrons emitted by the plasma. Their energy was about 2.45 MeV. (tr-auth) (France)

51717 SIMPLE METHOD OF DETECTION OF HIGH-ENERGY LOW-INTENSITY X-RAY IN THE PRESENCE OF A LOW-ENERGY HIGH-INTENSITY X-RAY BACKGROUND. Friedman, M. (Cornell Univ., Ithaca, N. Y.). Plasma Phys.; 12: 293-4(Apr 1970).

In some plasma devices it is sometimes necessary to detect high-energy x-ray fluxes of relative low intensity with a high background of low-energy x rays. The usual technique uses scintillator counters with different absorbers to discriminate between different components of x rays according to their energies. Since it is known that a Cherenkov counter can be used to monitor high fluxes or γ rays, the possibility of using this technique to measure the energies of high-energy x-ray photons was investigated. (auth) (UK)

51718 INTERACTION OF A VLASOV SYSTEM WITH DISSIPATIVE STRUCTURES. Woods, C. H. (Univ. of California, Livermore). Plasma Phys.; 12: 361-87(Apr 1970).

Previous analysis of the dynamical behavior of an E-layer magnetically coupled to external resistive circuitry has shown that the self-induced drag forces can be used to trap an incoming layer of electrons injected with an initial velocity lying inside the loss cone. By employing a special representation of Green's function, one is able to extend the calculations to include the injection of more than one bunch, and to examine several dynamical effects that appear when the amplitude of the E-layer becomes large. (auth) (UK)

51719 SYSTEMATIC SHAPING OF |B| ON FLUX SURFACES IN AXISYMMETRIC TOROIDAL SYSTEMS. Halbach, Klaus; Anderson, Oscar A.; Fuss, Dieter (Univ. of California, Livermore). Plasma Phys.; 12: 207-15(Apr 1970).

An axisymmetric system for toroidal confinement of low-β plasma is considered that consists of an internal ring (or rings), external trim coils, and an azimuthal-field winding. Plasma current is assumed to have negligible effect on the field. The machine currents produce easily calculated flux surfaces and constant-B surfaces. The relative shape of these surfaces (i.e., the variation of B over the flux surfaces and normal to them) plays an important role in calculations of plasma stability. When designing experimental tests of these calculations, one wishes to control this B-variation in specified ways. The technique described here can systematically find the machine currents required in many such cases. (auth) (UK)

51720 HELICAL MAGNETIC CONFIGURATION (TORSATRON) WITH AXIAL CURRENTS. Loktionov, Yu. M.; Sebko, V. P. Sov. Phys.-Tech. Phys. (Engl. Transl.); 15: 289-91(Aug 1970). Translated from Zh. Tekh. Fiz.; 40: 389-92(Feb 1970).

A torsatron magnetic configuration with the number of helices l = 3 is discussed under the condition that current flows in a definite direction along the geometric axis of the system (through a central conductor or through the plasma). (auth)

51721 ACCELERATION MECHANISM FOR NEUTRON PRODUCTION IN PLASMA FOCUS AND z-PINCH DISCHARGES. Bernstein, Melvin J. (Aerospace Corp., El Segundo, Calif.). Phys. Fluids; 13: 2858-66(Nov 1970).

A model was developed for the acceleration of deuterons in the tightly compressed column of a z-pinch discharge, in particular, that of a plasma focus discharge. It was assumed that an annular distribution of current undergoes a rapidly contracting transition to a distribution peaked on axis and the resulting crossed fields, B_θ and E_z, were used to calculate deuteron trajectories in the plasma. These results show that a significant number of ions can be accelerated to energies of up to 600 keV and that they have a large value for their time-averaged axial velocities. The orbiting motion in the magnetic field produces an anisotropic distribution of collision velocities and a neutron-production model based upon nuclear collisions by these deuterons can account for the measured characteristics of neutron energies, neutron fluxes, and rates of production. (auth)

51722 SPONTANEOUS FIELD REVERSAL IN THETA PINCHES. Morse, R. L.; Stoval, E. J. Jr. (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids; 13: 2867-70(Nov 1970).

A model is proposed to account for spontaneous magnetic field reversal which is observed in high-temperature θ-pinch plasmas early in the compression phase. The model assumes a large anomalous viscosity in the electron cloud and collisionless ion behavior. (auth)

51723 APPARATUS FOR GENERATING FUSION REACTIONS. Hirsch, Robert L. (to International Telephone and Telegraph Corp.). U. S. Patent 3,530,036. 22 Sep 1970. Filed 15 Dec 1967.

The apparatus described consists of a generally spherical anode that has concentrically positioned therein a generally spherical cathode permeable to charged-particle flow. The cathode is hollow and defines a volume centrally located with respect to both the anode and the cathode. This volume is free of tangible structure. A fusion-reactive gas is contained within the volume. Ion-producing devices are mounted on the exterior of the anode and are spherically spaced and diametrically aligned in pairs. Each ion-producing device is provided with a drift chamber, interposed between a plasma region and the anode, for receiving ions. Focusing electrodes may be contained within each ion-producing device which, in cooperation with both the anode and cathode, serve to accelerate ions toward the center of the cathode volume along paths which are essentially radial. (auth)

51724 APPARATUS FOR GENERATING FUSION REACTIONS. Hirsch, Robert L.; Meeks, Gene A. (to International Telephone and Telegraph Corp.). U. S. Patent 3,530,497. 22 Sep 1970. Filed 24 Apr 1968.

A generally spherical or cylindrical anode has concentrically positioned therein an ion-source grid and a cathode, both generally spherical or cylindrical and permeable to charged-particle flow. The grid is interposed between the anode and cathode, and the cathode is hollow, defining a volume centrally located with respect to all three of the anode, grid and cathode electrodes. This volume is free of tangible structure. A fusion-reacting gas is contained within the volume. A voltage is applied to the three electrodes for establishing a first electric field in the space between the anode and grid and a second electric field in the space between the grid and the cathode. The ion-source grid is at a positive potential with respect to both the anode and cathode. The second electric field is of sufficient magnitude to impart fusion-reacting energies to particles of positive charge introduced

into the second space. A thermionic cathode is positioned in the first space between the anode and grid. (auth)

51725 MOVING ELECTRONS AS AN AID TO INITIATING REACTIONS IN THERMONUCLEAR DEVICES. Ruark, Arthur E. (to United States Atomic Energy Commission). U. S. Patent 3,527,977. 8 Sep 1970. Filed 3 Jun 1968.

High-energy molecular ions are injected into an evacuated container within a magnetic field into the path of an energetic oscillating electron stream, and the plasma created dissociates and/or ionizes the molecular ions into atomic ions. The resulting atomic ions are trapped by the magnetic field to form a circulating beam of atomic ions within the container. One or more pairs of opposing molecular ion beams may be utilized to strike each other in the electron stream for dissociation or ionization thereof, and, if desired, an energetic arc discharge may also be utilized in conjunction with the energetic oscillating electron stream as an aid in the process of forming the atomic ions. (auth)

51726 ENERGY CHARACTERISTICS OF PULSED PLASMA ACCELERATORS WITH DIELECTRIC EROSION. Kalygin, A. G.; Kozlov, N. P.; Koreshchenko, N. A.; Leskov, L. V.; Saenko, V. B. (Moscow Higher Technical School). Zh. Tekh. Fiz.; 40: 1202-5 (Jun 1970). (In Russian).

The Ragowski loop system was used in studies of plasma structure generated in rail accelerators. Data obtained on energy distribution during various stages of plasma formations, and on the losses sustained, contribute to future development of traps with dense hot plasma and increased confinement time. (R.V.J.)

Wave Phenomena

Refer also to abstracts 51617, 51681, and 51704.

51727 (AD-708519) STATUS REPORT ON EXPERIMENTAL OBSERVATIONS AND MEASUREMENTS ON THE ARL Q-DEVICE. Anton, H.; Friz, W. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Mar 1970. 37p. (ARL-70-37). NTIS.

The behavior of the ARL Q device is described for various operational conditions. Although the data so far measured do not suffice for a good quantitative description, an attempt is made throughout the report to bring a logical and consistent causality into the observed data. In this way one can classify three distinct oscillatory states from the experimental observations made on the Q device: first, "the clean integer harmonic frequency state;" second, "the discrete-frequency mode-coupling state"; and third, "the turbulent mixing state." These states are described in some detail. (auth) (USGRDR)

51728 (IPP-2/84) EXPERIMENTAL STUDY OF ELECTRON CYCLOTRON HARMONIC WAVES IN A MAGNETICALLY CONFINED LOW-PRESSURE GAS-DISCHARGE. Clinckemaillie, A. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Nov 1969. 72p. (In German). Dep. CFSTI (U. S. Sales Only).

The dispersion characteristics (frequency, wavelength) of electron cyclotron harmonic plasma waves (Bernstein waves) that propagate perpendicular to the magnetic field confining the positive column of a low-pressure argon gas discharge are studied. The waves are excited with small-amplitude, radio-frequency signals applied to a small-wire antenna; the wave-signal detection is done with another similar antenna connected to a superheterodyne receiver (transmission measurements). The experimental results show that, for a constant magnetic field and given frequencies, the longitudinal plasma waves propagate freely across the radially inhomogeneous plasma column with wavelengths that are functions only of the local plasma parameters (density n_e, electron thermal velocity v_T) provided f/f_{ce} is constant. (auth)

51729 (NP-18477) COMPENSATION OF RESONANCE PERTURBATIONS IN STELLARATOR MAGNETIC FIELD. Preprint No. 118. Ivanovskii, M. A.; Popryadukhin, A. P. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1970. 23p. (In Russian). Dep. NTIS (U. S. Sales Only).

Compensations of magnetic field resonance perturbations were achieved with the first type $(i/2\pi) = 1$ in the Tor-2 stellarator. The two upper harmonics $p = 1$, $q = 1$, and $p = 2$, and $q = 2$ were compensated. The method of compensation is described, and plasma confinement in the resonance is studied as a function of the degree of compensation. (tr-auth)

51730 (NP-18482) SPECTRA OF TURBULENCE OF WHISTLERS IN COLLISIONLESS PLASMA. Preprint No. 100. Livshits, M. A.; Tsytovich, V. N. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1970. 22p. (In Russian). Dep. NTIS (U. S. Sales Only).

Studies of nonlinear interactions and spectra of stationary turbulence of whistlers (helicons) showed that the law of conservation limited considerably the decay interactions of whistlers, although the matrix elements for the whistler decay interactions, exceeded the matrix elements for scattering on ions. Formulas obtained for induced scattering on ions also showed that the stationary solutions corresponded to the whistler energy collapse in the direction of the external magnetic field and formation of one-dimensional spectra. The decay of such waves is strongly forbidden. In the case of prevailing induced scattering on electrons, the stationary spectrum existed only in some specific instances. Disturbance in plasma isothermality may result in propagation of ion-acoustic waves whose interaction with whistlers are capable of changing, significantly, the whistler spectra. (R.V.J.)

51731 WEAK ION-ACOUSTIC SHOCK WAVES. Kakutani, Tsunehiko (Univ. of Newcastle upon Tyne, Eng.); Kawahara, Takuji. J. Phys. Soc. Jap.; 29: 1068-73(Oct 1970).

Weak nonlinear ion-acoustic waves in a plasma consisting of cold ions and warm electrons are investigated by using a nonlinear perturbation method. In the lowest order of perturbation, it is found that the system of equations for the ion-acoustic waves can be reduced to the following single nonlinear dispersive-dissipative equation:

$$\frac{\partial u}{\partial \tau} + u\frac{\partial u}{\partial \xi} + \mu\frac{\partial^3 u}{\partial \xi^3} - \nu\frac{\partial}{\partial \xi}\left(\frac{\partial u}{\partial \tau} + u\frac{\partial u}{\partial \xi}\right) = 0,$$

where u, ξ and τ are normalized velocity of ion-fluid, stretched space and time coordinates, respectively. The parameter μ is a measure of dispersion due to charge separation, whereas ν is a measure of dissipation due to electron-ion collisions. It is shown that the equation has either oscillatory (dispersion-dominant case) or quasi-monotone (dissipation-dominant case) shock wave solutions. (auth)

51732 OPTIMUM SECOND HARMONIC GENERATION IN INHOMOGENEOUS PLASMAS. Sodha, M. S.; Sawhney, R. L. (Indian Inst. of Tech., New Delhi). Plasma Phys.; 12: 239-46 (Apr 1970).

Using the earlier expression for the second harmonic component of the current density in an inhomogeneous plasma, subjected to an external alternating electric field, the authors have investigated the conditions for maximum efficiency of second harmonic generation in reflected and transmitted waves from a plasma slab when a plane electromagnetic wave is normally incident on it. (auth) (UK)

51733 DAMPED OSCILLATIONS IN PLASMA. Nandedkar, D. P.; Bhagavat, G. K. (Indian Inst. of Tech., Bombay). Int. J. Electron.; 29: 337-48(Oct 1970).

Eigenfrequency of electronic damped oscillations in a plasma is derived. These oscillations are, however, not sustained. Furthur sustained electronic damped oscillations in the plasma in the presence of an external electric field are analyzed. (auth) (UK)

51734 MODULATION OF MAGNETOPLASMA DUE TO MAGNETIC PERTURBATIONS. Prasad, R. Y.; Singh, R. N. (Banaras Hindu Univ., India). Int. J. Electron.; 29: 377-81(Oct 1970).

The propagation of low-frequency and low-amplitude magnetic perturbations in magnetoplasms is considered. The collisionless Boltzmann transport equation is solved for the first- and second-order perturbations. The second-order perturbation is found to grow with time and results in density modulation of the ambient magnetoplasma. The geophysical implications of density modulation are discussed. (auth) (UK)

51735 E-H CYCLOTRON ECHOES AS A NEW ECHO TYPE IN PLASMAS. Sauer, K.; Bachmann, P.; Wallis, G. (Zentralinstitut fuer Elektronenphysik, Berlin). Phys. Lett.; 32A: 488 (7 Sep 1970).

A new cyclotron-like echo type not based on a velocity-dependent collision-frequency mechanism is proposed for relaxation and diffusion measurements in plasmas. (auth)

51736 LOW-FREQUENCY ELECTROSTATIC WAVES IN A MAGNETIC FIELD WITH COLLISIONS. Ohnuma, T.; Hatta, Y.; Tsuzi, N.; Kizima, Y. (Tohoku Univ., Sendai). Phys. Lett.; 32A: 500-1(7 Sep 1970).

The effect of ion cyclotron frequency is detected in the electrostatic waves nearly perpendicular to the magnetic field, with some comments on collisional effects. (auth)

51737 CONTRIBUTION OF NEUTRALS TO THE LOW-FREQUENCY WAVES IN AN ARGON DISCHARGE. Anastassiades, A. J. (Democritus Nuclear Research Center, Athens); Valahas, Th. M. Phys. Lett.; 32A: 535-6(7 Sep 1970).

The contribution of the neutral atoms to the low-frequency back-

ward wave oscillations in an argon discharge was investigated by measuring the charged-particle density and the light intensity modulation at the same point in the plasma column. (auth)

51738 POSSIBLE MECHANISM FOR INSTABILITY IN A PERPENDICULAR COLLISIONLESS SHOCK WAVE. Lashmore-Davies, C. N. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). J. Phys., A (London); 3: L40-5(Sep 1970).

Bernstein waves which propagate in a direction opposite to the current flow in a perpendicular collisionless shock can have negative energy. These negative-energy waves can give rise to instability either by coming into resonance with the ion–acoustic wave or by dissipating their energy through ion Landau damping. In the second case the instability can take place for $T_i \gtrsim T_e$. (auth) (UK)

51739 EFFECT OF INHOMOGENEOUS MAGNETIC FIELD ON THE MODES OF BOUNDED PLASMAS. Poularikas, A. D.; Gong, C. (Univ. of Rhode Island, Kingston). Int. J. Electron.; 29: 281-6(Sep 1970).

The dispersion relations of the symmetric slow-wave mode propagating in a nonhomogeneous and anisotropic plasma bounded by two planes are discussed. It was found that symmetric modes propagating in a homogeneous plasma with a nonhomogeneous magnetic field have multiple allowed frequency bands that are affected by the degree of inhomogeneity of the magnetic field. (auth) (UK)

51740 DEPENDENCE OF ELECTROMAGNETIC PROPERTIES OF A SEMIBOUNDED PLASMA ON THE MECHANISM OF REFLECTION OF ELECTRONS FROM A SURFACE. Rezvov, A. V. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 688-99(1970). (In Russian).

The effect of the mechanism of electron scattering at the plasma boundary on the spectrum and damping of surface waves is considered. It is shown that at frequencies $\omega \leq \omega/\sqrt{2}$, the surface impedance, the dispersion equation of surface waves, and the expression for damping can be written in forms independent of the boundary conditions for the distribution function of electrons on the plasma surface. Simple formulas approximating the dispersion curves at the frequencies $\omega > \omega_p/\sqrt{2}$ in the systems with Maxwell and degenerated distribution of electrons are given. A possibility is considered of using the data on reflection of obliquely incident electromagnetic waves to explain the mechanism of electron scattering by the surface. (auth)

51741 GENERATION OF ELECTROMAGNETIC WAVES BY JET FLOWS IN PLASMA. Gavrilenko, V. G.; Lupanov, G. A.; Stepanov, N. S. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 700-5(1970). (In Russian).

The propagation of surface electromagnetic waves along a plasma jet is considered. The jet and unstable plasma interface is supposed to be sufficiently sharp. In the absence of the thermal motion and collisions, the dispersion equation is derived and it is shown that, under definite conditions, the equation admits unstable solutions. (auth)

51742 RELAXATION OSCILLATIONS OF PLASMA IN AN INHOMOGENEOUS HF FIELD. Brodskii, Yu. Ya.; Mironov, V. A. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 706-11(1970). (In Russian).

An experimental study was made of the low-frequency relaxation oscillations occurring in a plasma column of a Q device under the action of localized hf field of a ring condenser when the voltage on its plates exceeds some critical value. A mechanism of excitation of oscillations is proposed. (auth)

51743 LOW-FREQUENCY WAVES IN A MAGNETOPLASMA. Duncan, A. J.; Forrest, J. R. (Stanford Univ., Calif.). Phys. Lett.; 32A: 469-70(7 Sep 1970).

A simplified theory for a homogeneous plasma in a uniform magnetic field is developed, from which wave-propagation characteristics in good agreement with those observed on a helium discharge column are predicted. (auth)

51744 MIXING OF TWO MICROWAVES AND EMISSION OF LOW-FREQUENCY WAVES FROM A PLASMA SLAB. Jayaram, Sunita; Tripathi, V. K. (Indian Inst. of Tech., New Delhi). J. Phys., A (London); 3: 547-58(Sep 1970).

The generation of vlf waves as a result of nonlinear interaction of two microwaves with a plasma slab in the presence of a high dc field is investigated theoretically. The reflected and transmitted vlf power comes out to be very high compared with the case for high-frequency waves. The generated vlf power is found to be maximum for an optimum value of the nonlinearity parameter, which is a function of carrier mass, collision frequency and mass of the scatterer. The vlf power is also found to show maxima and minima at various slab thicknesses. (auth) (UK)

51745 EFFECT OF THE ELECTRON–NEUTRAL COLLISIONS ON SPATIAL ECHOES IN PLASMAS. David, Georges (Paris Univ.). Compt. Rend., Ser. B; 271: 408-10(17 Aug 1970). (In French).

The individual electron neutral collisions were shown to damp down the spatial echo exponentially, and to deform it by displacing it towards its source. (tr-auth) (France)

51746 PROPAGATION OF ION CYCLOTRON HARMONIC WAVE. Ault, E. R.; Ikezi, H. (Univ. of California, Los Angeles). Phys. Fluids; 13: 2874-6(Nov 1970).

Low-frequency electrostatic waves that propagate across the magnetic field are studied experimentally. The observed dispersion relation agrees with that of the ion cyclotron harmonic wave. Strong damping of the wave is observed. (auth)

51747 FREQUENCY SPECTRUM OF MICROWAVES SCATTERED BY TURBULENT PLASMA. Granatstein, V. L.; Phillips, T. O. (Bell Telephone Labs., Inc., Whippany, N. J.). Phys. Fluids; 13: 2810-16(Nov 1970).

Microwaves are scattered from plasma fluctuations produced by forcing gas in turbulent flow through a discharge tube. The frequency broadening of the scattered wave is studied as a function of several experimental variables including the magnitude and orientation of the wave vector and the extent of the scattering volume. The experiment is compared with a theoretical result that expresses the frequency broadening in terms of three distinct contributions: a Doppler broadening due to random convection of the plasma turbules; transit time broadening; and a non-Gaussian broadening due to spatial gradients in the mean convection velocity. It is shown that measurement of the frequency broadening can be used to estimate the level of gas velocity fluctuations with about 25% accuracy. (auth)

51748 BACKWARD-SCATTERING INSTABILITY OF CYCLOTRON HARMONIC WAVES IN NONLINEAR DECAY PROCESSES. Chang, R. P. H.; Porkolab, M. (Princeton Univ., N. J.). Phys. Fluids; 13: 2766-71(Nov 1970).

Experimental results are presented which demonstrate that a finite-amplitude traveling cyclotron harmonic wave may decay into two similar waves by the process of resonant mode–mode coupling. The results presented here are restricted to cases where the group velocity of one of the perturbed waves is in the opposite direction from that of the other perturbed wave. The important feature of this process is that considerable growth, both in time and space, can occur for the perturbed waves. The spatial growth of these waves is observed, and the wave amplitudes are in qualitative agreement with theory. Furthermore, the experiments provide a quantitative measure of the resonant mode–mode coupling coefficient for waves that propagate perpendicularly to the magnetic field in a warm plasma. (auth)

51749 INTERACTION BETWEEN HYDROMAGNETIC WAVES AND A TIME-DEPENDENT, INHOMOGENEOUS MEDIUM. Dewar, R. L. (Princeton Univ., N. J.). Phys. Fluids; 13: 2710-20(Nov 1970).

Consider a system made up of a hydromagnetic wave and the slowly varying background fluid in which it propagates. It is shown that both the effect of the background on the wave and that of the wave on the background may be derived from Hamilton's principle using the averaged hydromagnetic Lagrangian density. The waves propagate adiabatically, conserving the wave action, and act on the background via a wave pressure term. Total momentum, angular momentum, and energy are conserved. When many waves are superimposed, as in weak turbulence, the wave kinetic equation replaces the adiabatic conservation equation. The accuracy of the averaging approximation is examined, and it is shown that it may be extended to all orders in the inhomogeneity. Also, Eulerian and Lagrangian averaging are discussed. (auth)

51750 TRAPPED LOW FREQUENCY WAVES PROPAGATING ALONG A WARM PLASMA CYLINDER. Klevans, E. H.; Mitchell, J. D. (Pennsylvania State Univ., University Park). Phys. Fluids; 13: 2721-4(Nov 1970).

Trapped low-frequency ion modes propagating along a warm plasma cylinder imbedded in a dielectric are studied. The dispersion relation is given, allowing for arbitrary azimuthal dependence. Computer solutions are presented for dipole modes. Symmetric modes are also studied for comparison with experiments. It is found that the electron temperature needed to fit the data is lower than the predicted by probes. A heuristic model used by previous authors is shown to be an approximate solution of the exact dispersion relation. Finally, the feasibility of observing dipole modes is discussed. (auth)

51751 PARAMETRIC EXCITATION OF PURELY GROWING MODES IN MAGNETOPLASMAS. McBride, John B. (Princeton Univ., N. J.). Phys. Fluids; 13: 2725-7(Nov 1970).

Excitation of purely growing modes in magnetoplasmas by high-frequency, dipole electric fields oscillating at ω_0 is discussed. Analytic expressions are given for the threshold and growth rate just above threshold for long wavelengths when $k \perp B_0$. (auth)

51752 TRANSVERSE WAVE INSTABILITY: DRIVEN BY SHEAR FLOW IN AN UNMAGNETIZED PLASMA. Albright, Norman W. (Univ. of Maryland, College Park). Phys. Fluids; 13: 2728-34(Nov 1970).

An unmagnetized collisionless plasma, subjected to shear flow, develops temperature anisotropy that causes unstable magnetic waves to grow. Equations for such a plasma were numerically integrated in time. It was found that a steady state is approached that has constant phase relations between different spatial components of the magnetic field. Stabilization occurs when the ion gyroradius is equal to the typical wavelength of the magnetic waves. The coefficient of viscosity for this state depends on the local velocity gradient and on the density. (auth)

51753 DIPOLAR RESONANCES IN THE PLANE-WAVE SCATTERING BY AN AXIALLY MAGNETIZED PLASMA COLUMN WITH A PERFECTLY CONDUCTING CORE. Shodhan, Kuldip C.; Seshadri, S. R. (Univ. of Wisconsin, Madison). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas Propagation; AP-18: 726-8(Sep 1970).

The scattering of H-polarized plane waves by an infinitely long axially magnetized cylinder of uniform plasma with a perfectly conducting cylindrical core at its center is investigated for the case in which the radius of the plasma column is small in comparison with the wavelength of the incident wave. The total scattering cross section is found to have maxima at three resonant frequencies. The peaks of these resonances as well as the dependence of their sharpness on the various physical parameters are examined in detail. (auth)

51754 TWO-DIMENSIONAL INVERSE SCATTERING PROBLEM. Imbriale, William A.; Mittra, Raj (Univ. of Illinois, Urbana). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas Propagation; AP-18: 633-42(Sep 1970).

It is demonstrated that the knowledge of the incident field and the scattered far fields at one frequency may be employed to determine the size, shape, and location of a perfectly conducting scatterer. The reconstruction of the scattering body is accomplished via an analytic continuation procedure that generates the fields in the neighborhood of the scatter from the specified far-field distribution. The geometry of the body is then determined by locating a closed surface for which the total tangential electric field, i.e., the sum of the tangential components of the incident and scattered field, is zero. Whereas exact knowledge of the entire far field is sufficient to determine the scatterer, a technique is also given for size and shape determination when only part of the far field is available. Numerical examples of several different geometries are given for ranges of ka (a the largest dimension of the body) from 0.2 to 10. Geometries considered were elliptic and circular cylinders, conducting strips, and two cylinders. Plots of the fields reconstructed from the far-field data are compared to the known solutions, and the accuracy of the procedure is demonstrated. The effects of noise in the far-field pattern are also considered, and it is shown that even with noise levels of −20 dB the scattering geometry can be recovered. (auth)

51755 SLOWING-DOWN OF THE VELOCITY OF AN ION WAVE IN A NONISOTHERMAL PLASMA. Takamura, S.; Aihara, S. (Nagoya Univ., Japan). Lett. Nuovo Cim.; 4: 685-8(10 Oct 1970).

The experiments were performed in a cylindrical metallic vessel. The plasma was formed by ionizing collisions of electrons, accelerated by the cathode-screen anode arrangement, with neutral atoms. Ion waves are excited and detected by negatively biased grids. Typical recorded patterns are given of phase velocity, electron saturation current, and electron temperature as a function of electron current. (M.O.W.)

51756 MICROWAVE POWER ABSORPTION IN PLASMA. Bhagavat, G. K.; Vanvari, N. (Indian Inst. of Tech., Bombay). Indian J. Pure Appl. Phys.; 7: 778-80(Dec 1969).

Absorption of microwave power in plasma was investigated using a transmission cavity, excited in the TE_{011} mode, perturbed by a plasma column. The measurements were made in the X-band regions using air, argon and CO_2 gases in the discharge tube. The absorption is found to be independent of the nature of the gas used. In addition, the electron density and collision frequency were also determined from observed shifts in the resonant frequency and change in the Q of the cavity resonator. (auth)

51757 EXCITATION OF MAGNETOSONIC RESONANCE IN PLASMA CYLINDERS. Moskvin, Yu. L.; Rusanov, V. D.; Frank-Kamenetskii, D. A. Zh. Tekh. Fiz.; 40: 1137-43(Jun 1970). (In Russian).

It is shown that in induced magnetosonic excitation in plasma cylinders standing magnetosonic waves are also excited inside the section of the cylinder confined by the excitation contour. The longitudinal energy loss by the main mode (of purely radial oscillations) may be absent due to the waveguide expansion. The effects of resonance oscillations inside the contour and waveguide excitations coexist in the higher-type modes. (tr-auth)

51758 SURFACE WAVES IN PLASMA WITH OSCILLATING CURRENT. Sidorov, V. P.; Tsypin, V. S. Zh. Tekh. Fiz.; 40: 1177-84(Jun 1970). (In Russian).

Surface waves in the presence of a current oscillating along a constant magnetic field were studied, considering processes taking place in the skin layers. Data obtained revealed that oscillating currents in the skin layers contribute to building up of surface-type waves that may produce a significant influence on the lifetime of particles in plasma. (R.V.J.)

51759 GENERATION OF SECOND HARMONICS AND DECAY PROCESSES IN INHOMOGENEOUS PLASMA. Erokhin, N. S.; Moiseev, S. S. Zh. Tekh. Fiz.; 40: 1144-9(Jun 1970). (In Russian).

The coefficient of plasma wave transformation into second harmonics was found and data obtained proved to be in agreement with the data obtained previously for a homogeneous plasma layer. Peculiarities of decay processes in inhomogeneous plasma are discussed. (tr-auth)

51760 NONLINEAR WAVES IN MULTICOMPONENT COLLISIONLESS PLASMA. Lominadze, D. G.; Pataraya, A. D. (Inst. of Physics, Tbilisi, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 300-2(1970). (In Russian).

Nonlinear compression waves propagating across the magnetic field in a tricomponent quasi-neutral cold plasma and the waves propagating at an angle to the external magnetic field in a multicomponent cold plasma were studied previously. Results are given here of the analysis of steady and nonsteady linear waves propagating in multicomponent plasma in the absence of magnetic fields. (R.V.J.)

Shielding

Refer also to abstract 50500.

51761 (CTC-INF-952) DEVELOPMENT OF TWO-DIMENSIONAL DISCRETE ORDINATES TRANSPORT THEORY FOR RADIATION SHIELDING. Mynatt, F. R.; Muckenthaler, F. J.; Stevens, P. N. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). 11 Aug 1969. Contract W-7405-eng-76. 220p. Dep. CFSTI.

Thesis. Submitted by F. R. Mynatt to Univ. of Tennessee, Knoxville.

The purpose of this study is to extend the capabilities of the two-dimensional discrete ordinates method in order to provide accurate calculations for deep-penetration radiation transport problems. The basic method is generalized and improved and a complete technique for application is developed. A clean-geometry experiment was designed and executed, and the results are compared with calculations. The experiment comprises large slab shields exposed to a collimated reactor beam source. Fast neutron dose measurements were also made, including dose profiles at the exit faces of the slabs. Lead, polyethylene, laminated lead and polyethylene, and depleted uranium slabs were included in the study. A large number of calculations were performed and many comparisons are shown. (M.H.R.)

51762 (N-70-25328) TIME DEPENDENT MONOENERGETIC NEUTRON TRANSPORT IN A FINITE SLAB WITH INFINITE REFLECTORS. Newman, Perry Alan (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Dec 1969. 145p. (NASA-TM-X-62847). NTIS.

Thesis. Submitted to Virginia Polytechnic Inst., Blacksburg.

The initial-value transport problem of monoenergetic neutrons migrating in a thin slab surrounded by infinitely thick reflectors is solved, using the normal-mode expansion technique of Case. The results obtained indicate that the reflector may give rise to a branch-cut integral term typical of a semi-infinite medium while the central slab may contribute a summation over discrete residue terms. Exact expressions are obtained for these discrete-time eigenvalues, and numerical results are presented showing the behavior of real-time eigenvalues as a function of the material properties of the slab and reflector. These eigenvalues are finite in number and all of them may disappear into the branch cut or continuum as the material properties are varied; such disappearing

eigenvalues correspond to exponentially time-decaying modes. In the limit of purely absorbing reflectors or a bare slab, the present solution has the properties previously reported by others who used the Lehnel–Wing technique to solve corresponding problems. (auth)

51763 (N-70-28160) ELECTRON SHIELDING STUDIES: EXPERIMENTAL PROGRAM. Technical Summary Report, August 1, 1968–December 31, 1969. Costello, D. G.; Weber, H.; Lonergan, J. A. (Gulf General Atomic, Inc., San Diego, Calif.). 23 Jan 1970. Contract NAS8-11304. 118p. (NASA-CR-102661; GA-9907). NTIS.

The energy spectra of electrons transmitted through tin slabs were measured as a function of angle with respect to the incident beam. The measured results are compared with calculations generated by the ETRAN 15 Monte Carlo program. In addition, a formula was empirically derived from the data obtained during this experimental program that gives the energy and angular distributions for electrons emerging from a slab of material as a function of incident electron energy. Absolute bremsstrahlung energy spectra were measured as a function of angle from targets of tin of sufficient thickness for the electrons to lose all or a large fraction of their energy in the material. Incident electrons of 4.0 and 8.0 MeV were directed normal to the target. The results of these measurements are compared to ETRAN 15 calculations, as well as to the calculations of Dickinson and Lent. Bremsstrahlung yield measurements were also made on thin targets of silver and gold; these measurements are compared with those predicted from various bremsstrahlung cross section formulas. (auth) (STAR)

51764 (ORNL-tr-2359) NUCLEAR SHIELDING CALCULATION. NOTE NO. 2. ENERGY FLUX IN AIR DUE TO A PLANE, INFINITE, ISOTROPIC GAMMA-RAY SOURCE OF UNIFORM DENSITY. (Ministere des Armees, Paris (France). Direction Technique des Armements Terrestres). Translated for Oak Ridge National Lab., Tenn., from French report. 94p. Dep. CFSTI.

The interpretation of aerial measurements requires a knowledge of the γ-radiation spectrum at various altitudes above an area contaminated by radioactive fallout. The theoretical determination of these spectra consists of finding solutions to the photon transport equation for given boundary conditions. The transport equation is a Boltzmann equation, i.e., a continuity equation in the photon phase space which contains three spatial coordinates, two for the $\vec{\Omega}$ direction and one for the energy E. Under the assumption that γ radiation is propagated in an isotropic, homogeneous, infinite medium (eliminating boundary effects) and that it does not modify the properties of the medium, the transport equation is linear. As a result, it is only necessary to solve the following normalized problem: Given a plane, infinite source emitting a photon of energy E_0 per unit of surface, per unit of time and per unit of solid angle, what is the flux of energy $I_0(x,E)$ at a distance x from the plane, propagation taking place in normal air. Since the source has a very complex energy spectrum in the case of contaminated zones, solutions to the transfer equation must be found for several values of E_0; the linearity of the equation then makes it possible to reconstruct the energy flux at distance $\bar{x}$ as a function of the results obtained for the E_0 value of each elementary source. The form of the Boltzmann equation is used, which at point x furnishes not only the contribution of unscattered photons, but also that of photons which have undergone one or more scatterings on atomic electrons of the air; also, absorption due to photoelectric and pair production effects is taken into account. This Boltzmann equation is solved by the method of moments, and the results are presented. (M.H.R.)

51765 MULTIPLE ELECTRON SCATTERING. Galishev, V. S. This paper was summarized in At. Energ. (USSR); 24: 181(Feb 1968) as paper No. 182. (In Russian).

The solution to the problem of how electrons pass through a layer of a substance with multiple scattering and loss of energy is presented. The calculations are based on the equation of motion of the electrons with the approximation that the loss in energy is continuous. With the boundary conditions taken into consideration, this equation is transformed by the methods of Yvon, J. Nucl. Energy, 4: 305(1957) and Mertens, Compt. Rend., 237: 1644(1953). The result, in n-th approximation, is a system of 2n linear first-order partial differential equations for the coefficients of the current of scattered electrons as expanded in terms of Legendre polynomials. The scattering functions of the resulting system of equations are transformed by Spenser, Phys. Rev., 98, 1957(1955), and the numerical values of a number of parameters of the theory, by means of which these functions are determined, are calculated for electrons having energies of 0.1 to 2 MeV in aluminum. The final results of the above system of equations are given only for the case n = 1, which gives the spectral distribution of the current of scattered electrons at a given distance from the source. In the given case this can be accomplished by replacing the above system of equations by an equivalent system of Volterra integral equations and by searching their solution in the form of an expansion with respect to the orders of scattering. (auth)

51766 REFLECTION OF BETATRON BREMSSTRAHLUNG BY BARRIERS CONSISTING OF VARIOUS MATERIALS. Zol'nikov, P. P.; Golikov, E. G.; Sukhanova, K. A.; Dvinyaninov, B. L. This paper was summarized in At. Energ. (USSR); 25: 318(Oct 1968) as paper No. 237. (In Russian).

Results are cited of experimental measurement of the backscattering characteristics of betatron γ radiation with a maximum boundary energy $E_{\gamma max}$ = 9 and $E_{\gamma max}$ = 15 MeV for backscattering from plane barriers with a semi-infinite thickness consisting of plastic, aluminum, iron, and lead. The spectral distribution of the reflected radiation was analyzed as a function of the atomic number of the reflector substance and the nature of the primary-radiation spectrum. The measurements were performed by means of a scintillation spectrometer with total absorption. The spectrometer was surrounded by a monolithic lead shielding unit that guaranteed a primary-radiation attenuation factor of 10^4. The spectra of betatron bremsstrahlung with a maximum energy of 15 MeV reflected by lead, iron, aluminum, and plastic barriers are shown. It is demonstrated that the peaks in the energy range 0.5 to 0.6 MeV are due to annihilation radiation, while the peaks in the range below 0.3 MeV are due to γ-quanta that have undergone single and multiple scattering. A linear dependence of the intensity of the annihilation γ quanta on the atomic number of the reflector substance is observed in the reflected radiation. For the lead reflector, a fluorescence radiation peak is noted whose intensity increases with a decrease in average energy of the primary spectrum; this peak amounts to 46% for betatron radiation with $E_{\gamma max}$ = 15 MeV, while it is equal to 70% for radiation with $E_{\gamma max}$ = 9 MeV. (auth)

51767 SCATTERING OF FAST NEUTRONS BY IRON AND ALUMINUM BARRIERS. Gromov, V. P.; Zubov, Yu. F.; Pozdneev, D. B. This paper was summarized in At. Energ. (USSR); 24: 567(Jun 1968) as paper No. 179. (In Russian).

The spectral angular and integral characteristics for the transmission and backscattering of fast neutrons incident at various angles α (0, 15, 30, 45, 60, and 75°) on plane barriers of aluminum (thickness $5 \leq d \leq 30$ cm) and iron (thickness 2.5 to 30 cm) are calculated by the Monte Carlo method. Results are obtained for primary neutrons of energy E_0 = 3 and 14 MeV and also for the fission spectrum. The form of the differential spectra for various escape angles θ and the form of the integral spectra are discussed from the point of view of the excitation of individual levels of the ^{27}Al and ^{56}Fe nuclei due to the inelastic scattering of fast neutrons. The contributions of various scattered-neutron energy groups are considered for various barrier thicknesses and various angles α. (M.H.R.)

51768 DETERMINING THE GAMMA RADIATION LEAKAGE FROM A LONG SOURCE ROD THROUGH THE FLAT JOINTS OF THE SHIELD ASSEMBLY. Mirenkov, A. F. Sb. Tr., Mosk. Inzh.-Stroitel. Inst.; 56: 43-50(1968). (In Russian).

The shield thickness is given as a function of the size, configuration, and activity of a linear extended source. The position of the source with respect to the surface of the shield is varied. Multiple scattering of radiation in the shield from the extended source is taken into account. Formulas are presented for determining the radiation leakage from an extended source parallel to the seam of a shield assembly. These formulas give maximum values and can be used to approximate the actual values. (TTT)

51769 CALCULATION OF ABSORBED DOSE RATES IN A HOLLOW CYLINDRICAL RADIATOR HAVING A NONUNIFORM DISTRIBUTION OF ACTIVITY. Drozdov, V. E.; Ryabukhin, Yu. S. This paper was summarized in At. Energ. (USSR); 24: 463-4(May 1968) as paper No. 203. (In Russian).

An expression is given for the absorbed dose rate at a point on the base of a hollow cylindrical radiator having a nonuniform distribution of activity. Values of the attenuation of radiation from ring sources were calculated on a computer and tabulated for certain parameters. The tabulated data may also be used to calculate absorbed dose rates in a hollow cylindrical radiator having a uniform distribution of activity. (M.H.R.)

51770 DISTRIBUTION OF NEUTRONS FROM A Po-Be SOURCE IN A HYDROGENOUS MEDIUM. Samosadnyi, V. T.; Lekhtmakher, S. O. This paper was summarized in At. Energ. (USSR); 25: 47-8(Jul 1968) as paper No. 213. (In Russian).

The optimum arrangement of neutron source and detector in a neutron–isotopic data unit depends on the distribution of neutrons scattered by the process medium. The steady-state distributions of thermal and intermediate neutrons from an external Po–Be

source near a cylindrical container of water were computed in the three-group diffusion approximation. Thermal-neutron absorption in hydrogen was taken into account in the calculation. The energy groups were selected so that the cross section for the transfer of neutrons from the fast to the thermal group was small. The distribution of thermal and intermediate neutrons in the azimuthal plane is formulated. The number of thermal and intermediate neutrons at points around the scattering medium was determined by using a LiI(Eu) scintillation detector and a cadmium filter. The processed experimental results differ from the calculated values for the thermal group by about a factor of 1.7. This difference can be explained by the geometric factor in counting scattered neutrons, the counting efficiency, and the attenuation of the thermal neutron current in structural elements. The number of thermal neutrons produced in the water is about 35 to 40% of the total number of neutrons recorded by the LiI(Eu) crystal. This result is important in choosing the detector in a neutron–isotopic data unit since the counting efficiency of gas-filled boron counters or counters clad with a boron-containing solid is no more than 40% for thermal neutrons. The results obtained show the possibility of using the calculational method described to determine the thermal neutron distribution around scattering media. In making a neutron–isotopic data unit it is necessary that the source-detector distance be minimum. (auth)

51771 TRANSMISSION OF FAST NEUTRONS AND GAMMA RAYS THROUGH RECTANGULAR SLOTS. Broder, D. L.; Kozlovskii, S. A.; Kyz'yurov, V. S.; Popkov, K. K.; Smetanin, A. A. This paper was summarized in At. Energ. (USSR); 25: 517-18 (Dec 1968) as paper No. 249. (In Russian).

The ray method was used to calculate the radiation flux outside a shield containing rectangular slots. Calculations were made of fast neutron fluxes and gamma dose rates outside shields of various compositions containing inhomogeneities of this type. The calculated results were compared with the experimental data. The core of a research reactor was used as a radiation source and plane isotropic sources were mocked up with Po–α–Be and ^{60}Co sources. A comparison of the calculated and experimental data presented shows that the proposed method may be used in practical calculations if radiation scattering is properly accounted for. (M.H.R.)

51772 CALCULATING THE ANGULAR DISTRIBUTION OF MONOENERGETIC ELECTRONS SCATTERED IN MATTER. Belyaev, A. A.; Krupman, A. I. This paper was summarized in At. Energ. (USSR); 25: 222(Sep 1968) as paper No. 223. (In Russian).

A scheme is suggested for performing calculations of the spectral and integral characteristics of fast electrons scattered in matter by the Monte Carlo method. The basis of the scheme is the method of splitting the scatterer into thin layers for which the spectral characteristics of the scattered electrons are calculated while taking individual collisions into account. If the thickness l is less than the mean free path λ_e between two elastic collisions, then the length of a step on the trajectory is chosen from the Poisson distribution; if, however, $l \geq \lambda_e$, then the length of a step is assumed equal to λ_e. In order to take into account the dependence of the length of the step on the electron energy, inelastic collisions are simulated. The mean free path between inelastic collisions is assumed equal to an average length λ_i, and the energy lost during a collision is chosen from the distribution of the energy loss during inelastic collisions. Such a procedure for plotting the trajectory makes it possible to take into account the contribution of single and multiple elastic and inelastic collisions. For thicknesses much greater than λ_e the length of the step is chosen equal to l, which is the thickness of the thin layer; the magnitude of this thickness is chosen on the basis of the optimal computing conditions. The energy and angular distributions for the chosen step length are calculated using the first part of the calculation scheme. As an example the results of calculating the penetration factor and angular distribution of electrons with energy E = 20 keV that were elastically scattered in copper foils with thicknesses of 38.4 and 80.4 $\mu g/cm^2$ are cited. The results of the calculation are compared with the experimental data obtained by Cosslett [Brit. J. Appl. Phys., 15 883 (1964)] for a foil 38.4 $\mu g/cm^2$ thick. The sensitivity of the results of the count to the choice of screening parameter μ is also considered. (auth)

51773 SOURCE AND DETECTOR GEOMETRY REDUCTION IN EVALUATION OF EXPERIMENTS IN SHIELDING PHYSICS. Holman, Miloslav (Skoda-Works, Plzen, Czech.). Jad. Energ.; 16: 325-9(Oct 1970). (In Czech).

The nonpoint geometry of radiation detectors and sources used experimentally leads to difficulties in the generalization of space radiation field measurement results and in comparison with calculations. A method for transformation of results obtained with a nonpoint detector or source to results corresponding to a point detector or source is presented. (M.H.R.)

51774 BACK SCATTERING OF γ-RADIATION BY HETEROGENEOUS BARRIERS. Pozdneev, D. B. This paper was summarized in At. Energ. (USSR); 25: 227(Sep 1968) as paper No. 230. (In Russian).

The results are given of an experiment on the study of the effect of shielding coatings consisting of heavy materials (iron, cadmium, lead) on the albedo from light-weight scatterers (graphite, aluminum) in two geometries: 1) for normal incidence of a narrow beam of primary quanta, and 2) for the case when a point isotropic source is in close contact with the reflector. The ^{137}Cs isotope was used as the source in both cases. The effect of coatings on the magnitude of the integral albedo was studied; the change in the shape of the energy spectrum when the contributions from single and multiple scattering processes are taken into account is discussed. An example of the curves obtained for the numerical differential albedo $A(\theta)$ is shown when graphite (thickness 6.6 cm) was used as the basic material and the coatings consisted of cadmium and cadmium with lead for a geometry involving a point isotropic source in close contact with the scatterer. (auth)

51775 SOLUTION OF THE TRANSPORT EQUATION BY THE METHOD OF CHARACTERISTICS. Bass, L. P. This paper was summarized in At. Energ. (USSR); 28: 49-50(Jan 1970) as paper No. 360/5343. (In Russian).

Use of the method of characteristics with interpolation in a calculation of two-dimensional shielding with axial symmetry has shown the good quality of the difference scheme, particularly with regard to the stability for comparatively open grids. A shortcoming of the algorithm is the awkardness of its logical scheme. It has been suggested that this method be modified to combine the writing simplicity of the S_n method and the good quality of the method of characteristics. As a result, a modification of the method was developed in which the logical scheme of the calculation was simplified through the use of rectified cell boundaries. This permits the same writing form for the method of characteristics as for the S_n method facilitating a comparison of these methods. This comparison shows that the method of characteristics is not surpassed by the S_n method in the algorithmic sense. (M.H.R.)

51776 ESSENTIAL PHYSICS DATA. Cameron, J. R. (comp.). pp 65-86 of Handbook of Radioactive Nuclides. /Wang, Yen (ed.). Cleveland; Chemical Rubber Company (1969).

Graphs, tables, figures, equations, and definitions are presented illustrating data pertaining to radiation interactions with matter. The data pertain primarily to absorption coefficients, range–energy relations, penetration ability, radioactive decay, statistical-error calculations, resolving-time calculations, and statistics of counting. (E.R.B.)

51777 MONTE CARLO CALCULATION OF NONSTATIONARY DISTRIBUTIONS OF NEUTRONS AND CAPTURE γ-RAYS IN NUCLEAR GEOPHYSICS PROBLEMS. Gommershtadt, V. Ya.; Denisik, S. A.; Lukhminskii, B. E.; Rezvanov, R. A. This paper was summarized in At. Energ. (USSR); 28: 51(Jan 1970) as paper No. 362/5264. (In Russian).

A modification of the Monte Carlo method is used to calculate the spatial and time distributions of neutrons and radiative-capture γ rays in media with one cylindrical or two coaxial boundaries. The slowing down of neutrons to thermal energy and the basic elements of trajectories during diffusion are calculated by the Monte Carlo method. However, scattering–capture decisions are not made by chance in this scheme. Instead a weight function is introduced representing the probability of a neutron avoiding capture after j encounters. Its value is determined by the recurrence formula. Neutron and γ fluxes are computed simultaneously in three-layer media with various radii of the zone of invasion R by using the scheme of correlated trajectories which decreases the error in the determination of the ratio of the radiation fluxes in media with different R values. Some results of the calculation of spatial and time distributions of neutrons and γ rays in three-layer media (a cylindrical bore-hole filled with water; a zone of borehole filtrate invasion in the bed; a bed filled with oil or salt water) are presented. The results of the calculation indicate an advantage of the pulsed neutron–γ method over the pulsed neutron–neutron method for measurements in the working range of delay times (600 to 1700 μsec). It was established that the first method has a radius of investigation which is 10 to 15 cm larger than that for the second method and this difference is maintained for all delay times. (M.H.R.)

51778 PREDICTION OF RESIDUAL FLUXES OF HEAVY PARTICLES ESCAPING RADIOACTIVE SURFACES. Romero, Jacob B. (Boeing Co., Seattle). Nucl. Sci. Eng.; 42: 49-57 (Oct 1970).

Radioactive particles escaping a surface carry a portion of the disintegration energy. The fluxes of particles, power, and energy are referred to as residual fluxes. A method is formulated for predicting residual fluxes emanating from a composite surface consisting of an active substrate layer protected by a clad layer. Application of this method requires only knowledge of the particle ranges in the layer materials. Using existing range–energy equations, generalized plots are presented for estimating residual quantities for heavy particles. Calculations show that fractional residual power and particle fluxes vary from 0.5 for thin (monoatomic) layers to zero for very thick layer or heavily cladded systems. Typical values of the residual power are 0.1 W/cm^2 for alpha particles and 10 W/cm^2 for fissioning surfaces. (auth)

Solid-State Physics

51779 FERROELECTRIC MATERIALS AND FERROELECTRICITY. Connolly, T. F.; Turner, Errett (eds.). Solid State Physics Literature Guides. Volume 1. New York; Plenum Press (1970). 685p.

This volume contains about 3,300 references that are indexed in depth (subject, author, organization, patent, and report number). The references are grouped both by materials and properties, and a keyword-in-context list is included. The permuted title index includes entries from 1962 through 1969. (D.L.C.)

Radiation Effects

Refer also to abstracts 50400, 50654, 51239, and 51577.

51780 (AD–707080) RADIATION EFFECTS IN SILICON AND GERMANIUM. Final Report. Curtis, O. L. Jr.; Srour, J. R.; Bass, R. F.; Wikner, E. G. (Northrop Corporate Labs., Hawthorne, Calif.). Mar 1970. Contract DAAG39-69-C-0039. 192p. (HDL–69-39-1). NTIS.

Results of several related studies of radiation effects in silicon and germanium are described. Studies of short-term annealing phenomena in silicon include a comparison of the effects of fusion- and fission-neutron irradiation on n- and p-type material, an investigation of transient recovery following pulsed-electron irradiation, and an analytical treatment of the effects of metastable charge states on short-term annealing p-type material. A model to explain observations of "radiation-induced annealing" in terms of trapping is presented. An investigation of various aspects of excess density studies in bulk material was performed, including the use of a Nd: glass laser to achieve high excitation levels in silicon. A method is presented for determining capture probability temperature dependences in semiconductors. The recombination properties of ^{60}Co gamma-irradiated n-type germanium were determined for low-resistivity material and a study of dose effects was performed. Studies were made on the influence of lithium, aluminum, and oxygen on the radiation sensitivity of silicon. (auth) (USGRDR)

51781 (AD–707690) EFFECT OF STRESS ON THE LUMINESCENCE SPECTRUM OF IRRADIATED SILICON. Jones, Colin Elliott (Illinois Univ., Urbana. Coordinated Science Lab.). May 1970. Contract DAAB07-67-C-0199. 203p. (UILU-ENG–70-211). NTIS.

Thesis.

Silicon crystals that have been irradiated with neutrons, high-energy electrons, or gamma rays at room temperature, show two strong luminescence bands in the near infrared. Both bands have a sharp zero-phonon line followed by a series of broad phonon-assisted peaks. The higher-energy band associated with a zero-phonon line at 0.97 eV is independent of any impurities, while the lower energy band with a zero-phonon line at 0.79 eV is seen only in silicon containing oxygen. Data on the temperature and stress dependence of the luminescence bands were taken in order to obtain information on the type of defects and the optical transitions involved. The narrow line widths observed for the zero-phonon lines show that the transitions do not involve a free carrier. The zero-phonon line at 0.79 eV is a doublet showing thermal population effects that relate it to two levels in the initial state. The lack of any association with impurities, the annealing, and the stress data for the bands associated with the 0.97-eV zero-phonon line all support an identification of these bands with divacancy. (auth) (USGRDR)

51782 (AD–708734) RADIATION EFFECTS IN SEMICONDUCTING LASER MATERIALS. Final Report, December 1, 1968–November 30, 1969. Compton, W. Dale; Ahlburn, Byron T. (Illinois Univ., Urbana. Coordinated Science Lab.). May 1970. Contract F33615-69-C-1251. 44p. (ARL–70-76). NTIS.

High-resolution spectra of the spontaneous and stimulated luminescence in CdSe were investigated as functions of excitation intensity and temperature. In addition to the spontaneous emission lines, numerous laser lines and their cavity modes were observed. Some of the laser lines appear to be correlated with spontaneous emission lines reported and interpreted by other investigators. Two of these lines were observed to saturate and then to disappear as the excitation intensity increases. In one sample, a pronounced shift of the cavity modes to shorter wavelength was observed as the excitation is increased. Preliminary investigations of the effects of bombardment with 1.5-MeV electrons on the luminescence were made. These early observations indicate that irradiation with electrons shifts the laser action to shorter wavelengths. (auth) (USGRDR)

51783 (CEA-CONF–1585) IRRADIATION DEFECTS IN GOLD. Masounave Bounahoum, Jacques (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1970. 3p. (In French). (CONF-700809–2). Dep. CFSTI (U. S. Sales Only).

From 7th International Congress on Electron Microscopy, Grenoble, France.

Results obtained from the irradiation of crystalline gold samples (500 to 1000 Å) in the Triton reactor by fission fragments from a thin enriched uranium source (500 Å) are given. Variation of density of the clusters observed by electron microscopy was studied as a function of the thickness of the absorber placed between the source and the gold crystal; variation of the number of clusters was then studied as a function of the particle fluence. A 60-Å depth area without any defects was observed. The maximum (extrapolated) range of a light particle was 6.4 μ and that of a heavy particle 5.1 μ. The heavy fragments produced 110 visible clusters and the light fragments 60 clusters. A good correlation was found between the theoretical results concerning energy losses by atomic collisions and the number of defects observed in the microscope. (tr-auth) (France)

51784 (CEA-N–1294) IRRADIATION DAMAGE FROM PILE NEUTRONS. DETAILED CALCULATIONS ON THE ATOMIC PROCESSES INVOLVED. PROGRAM SOURCE. Chabry, P.; Genthon, J. P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1969. 91p. (In French). (DPE/SPE–69-504). Dep. CFSTI (U. S. Sales Only).

The displacements of atoms and various charged particles in materials subjected to neutron irradiation were studied. These displacements may occur as a result of elastic or inelastic collisions, or by nuclear reactions: (n,p), (n,α) and (n,γ). For each of these cases, the energy spectra of the charged particles and the energy given up to the lattice were calculated. The phenomena associated with the slowdown of these charged particles, particularly the ions, were studied. Electronic collisions ionizing the atoms, and nuclear collisions between ions and lattice atoms were distinguished. The latter only, by giving rise to a cascade motion of the atoms creating interstitial hole pairs and displaced zones, induce defects in the materials. The mean free path between collisions, the energy given up to the lattice, the energy spectra of the secondaries produced, and the total paths etc. were calculated. The source program used for these calculations was described. Results were obtained for the neutron bombardment of iron and tungsten and for the slowdown of fission products in uranium and iron. (auth)

51785 (CEA-R–3882) CHARACTERIZATION OF JUNCTIONS PRODUCED BY MEDIUM-ENERGY ION IMPLANTATION IN SILICON. Monfret, Alain (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Jun 1970. 109p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Characteristics of diodes made by implanting 20-keV boron and phosphorus ions into silicon are reviewed. Special features of these diodes are presented, and the correlation with technology is studied. The theory of range distribution is considered for both amorphous and single-crystal targets. A brief description of the experimental conditions is given. The experimental results are presented. The results lead to a schematic model of the component. They also show the influence of cleaning and annealing treatments from which optimized process of fabrication can be determined. In this study, the influence of a two-stage annealing process is shown. For phosphorus and boron implants, the first stage is performed at 150°C while the second stage is 450°C for phosphorus and 550°C for boron implants. The implanted diodes are found to exhibit good electrical characteristics. Comparisons with standard diffused diodes are quite favorable. 94 references. (auth)

51786 (COO–1441-12) A STUDY OF THE DEFECT STRUCTURE OF NONSTOICHIOMETRIC CeO_2. Technical Progress Report. Blumenthal, Robert N. (Marquette Univ., Milwaukee,

Wis. Coll. of Engineering). Sep 1970. Contract AT(11-1)-1441. 23p. Dep. CFSTI.

The electrical conductivity of a single crystal of $Ce_{1+y}O_2$ has been measured as a function of temperature and oxygen pressure. For comparative purposes the conductivity data obtained on sintered specimens has been normalized for porosity using the relation $\sigma_{normalized} = \sigma_{measured}(\rho_{theoretical}/\rho_{measured})$. The agreement between the normalized conductivity values and the single-crystal data in the temperature range 1200°–1500°C was excellent. The electrical conductivity of sintered specimens of CaO-doped CeO_2 have also been measured as a function of temperature and oxygen pressure. At large departures from stoichiometry $\sigma_e > \sigma_i$ and at small departures from stoichiometry $\sigma_i > \sigma_e$. An estimate of the mobility of oxygen vacancies, 6×10^{-5} cm²/volt-sec at 800°C, was obtained from this data. Preliminary data on the ionic transference of a 2 mole % CaO-doped CeO_2 specimen indicates that $t_i \sim 0.75$ at high oxygen pressures (i.e. ~1 atm) in the temperature region 800° to 1050°C. The compositional dependence of the thermodynamic quantities $\Delta\bar{H}_{O_2}$ and $\Delta\bar{S}_{O_2}$ were determined from the thermodynamic data. Near stoichiometry (i.e. $y \sim 0$) $-\Delta\bar{H}_{O_2} = 10.4$ eV was shown to be equal to the enthalpy of the defect reaction $5Ce_{Ce} + 2O_0 = Ce_i^{+4} + 4\,Ce'_{Ce} + O_2(g)$. (auth)

51787 (N-70-25815) STUDY OF DOPANTS FOR RADIATION-RESISTANT SILICON. Quarterly Report. (Northrop Corporate Labs., Hawthorne, Calif.). Apr 1970. Contracts NAS7-100; JPL-952523. 21p. (NASA-CR-109623; NCL-70-27). NTIS.

Lifetime degradation produced by ^{60}Co gamma radiation was investigated in bulk silicon containing aluminum or lithium dopants. These investigations were performed to determine whether material containing these impurities is more resistant to radiation than is material which contains the more conventional dopants boron and phosphorus. (auth) (STAR)

51788 (N-70-26555) DEVELOPMENT OF RADIATION RESISTANT INSULATING LAYERS FOR PLANAR SILICON TECHNOLOGY, MAY 29, 1968–JUNE 28, 1969. Donovan, R. P.; Simons, M.; Monteith, L. K. (Research Triangle Inst., Durham, N. C.). May 1970. Contract NAS1-8156. 50p. (NASA-CR-1584). NTIS.

Two methods were investigated for improving the radiation resistance of thermal oxides on silicon: ion implanation and evaporation of SiO. The more promising method is that in which the properties of the thermal oxide were modified by an ion implantation process. This method of radiation hardening retains the advantages of thermal oxidation techniques and requires only the degradation of a specific property; the electron lifetime in the oxide. Investigations were conducted on implantations sufficiently high in fluence to introduce a small shift into the initial C–V characteristic of the MOS capacitor structure used for evaluating the modification. The magnitude of the shift is small when compared to the improvement in radiation hardness and varies with fluence. (auth) (STAR)

51789 (N-70-28137) INVESTIGATION OF THE STRUCTURE OF RADIATION DAMAGE IN LITHIUM-DIFFUSED SILICON. Final Report, February 3–December 8, 1969. Corelli, J. C.; Mortka, T. (Rensselaer Polytechnic Inst., Troy, N. Y. Div. of Nuclear Engineering and Science). Dec 1969. Contracts NAS7-100; JPL-952456. 52p. (NASA-CR-11001). NTIS.

The effects of 1.5- and 5-MeV electron irradiation on Li-doped silicon were studied, using infrared photoconductivity and infrared spectroscopy to probe the radioinduced defects. The lithium was diffused in samples cut from oxygen-rich crucible-grown silicon ingots or from oxygen-lean floating-zone-refined silicon. In all samples studied, the starting material before Li diffusion had resistivities in the range 1 to 10 ohm-cm, phosphorus-doped. The lithium was diffused by heating to approximately 420°C a paste mixture of lithium metal in mineral oil and alumina painted on the surface. From the photoconductivity measurements, an energy level was found at $E_c = 0.62$ eV, which acts as an electron trap and is produced by radiation in nearly all samples irrespective of oxygen content. Other levels that give rise to defect photoconductivity are produced with predominant concentration. Strong lithium effects were observed on the 1.8-micron divacancy-associated defect absorption band in which less of the 1.8-micron band is produced as the lithium concentration is increased. Absence of a clear divacancy level was found for all lithium concentrations studied that may be due to their low production rate at ~1.5 to 5 MeV. (auth) (STAR)

51790 (N-70-30590) EFFECTS OF SPACE-PARTICLE BOMBARDMENT ON SOLAR-CELL MATERIALS. de Wys, E. C.; Bhansali, K. J. (Denver Research Inst., Colo.). Mar 1970. Contracts NAS7-100; JPL-952533. 75p. (NASA-CR-110408; DRI-2540). NTIS.

For Jet Propulsion Lab., Pasadena, Calif.

It is intended to determine the effect of proton bombardment on silicon solar cells. The research is carried out in three separate areas of electronic measurements, electron microscopy, and x-ray topography. Experimental approach and results of the latter two techniques are discussed. The Lang method was employed for x-ray topography. Presence of numerous edge and loop dislocations was noticed before irradiation. After irradiation, the edge dislocation showed up as spiral dislocations indicating that a chemical force was set up due to irradiation. The chemical force is probably related to the creation of radioinduced vacancies. Presence of striations at right angles to the electrode due to variation in dopant concentration was noticed. Electron microscopy was done with 100-kV electrons to get maximum resolution. Types of defects present were found to be independent of fabrication method but their concentrations vary. Proton irradiation caused 3- to 4-fold increase in the density of unknown type of defects. (auth) (STAR)

51791 (ORNL-TM-3158) RADIATIVE DECAY OF COULOMB-STIMULATED PLASMONS IN Al, Be, AND Mg. Braundmeier, A. J. Jr.; Arakawa, E. T.; Williams, M. W. (Oak Ridge National Lab., Tenn.). Oct 1970. Contract W-7405-eng-26. 100p. Dep. CFSTI.

Thesis. Submitted by A. J. Braundmeier Jr. to Univ. of Tennessee, Knoxville.

Intensity peaks in the vacuum–ultraviolet radiation spectrum emitted from electron-bombarded thin metallic films evaporated in situ were analyzed in terms of an interaction between the incoming electrons and surface plasma states in the metal. The primary effort was a study of the nonradiative surface plasmon modes in Al. These modes, which cannot decay radiatively from smooth planar films, are capable of decaying by photon emission through their interaction with surface roughness present on experimental films. The basis on which the experimentally observed intensity peaks were identified as arising from plasmon decay were: (1) the wavelength of the resonance peak, (2) the dependence of the intensity and peak wavelength on the presence of thin oxide layers on the metal, and (3) the dependence of the intensity upon the surface structure of the Al film. Other parameters investigated in order to determine their influence upon the radiation yield of the plasmons are: (1) the film thickness, (2) the film age, (3) the electron incidence angle, and (4) the incident electron velocity. Also considered were the radiative surface plasmon (volume plasmon) modes in thin Mg and Be films evaporated onto electropolished Ta substrates. An experimental determination of the plasma energy was made for both metals and compared with values obtained by different investigators using other techniques. In addition, a value for the intrinsic damping constant for Mg was determined. (auth)

51792 EXCITATION OF ELECTRONS ACROSS Al_2O_3 INSULATING BARRIERS BY PROTON BOMBARDMENT. Lee, R. S.; Sethna, P.; Crawford, J. L. (Kansas State Univ., Manhattan). J. Appl. Phys.; 41: 4658-65(Oct 1970).

Measurements were made of the current excited across Al_2O_3 insulating barriers by proton bombardment. Films of Al_2O_3 sandwiched between thin metal electrodes were bombarded by a monoenergetic beam of protons from a low-energy accelerator. The Al_2O_3 was grown by anodic oxidation on films of Al which had been deposited on glass substrates. The Al_2O_3 films ranged in thickness from 100 to 600 Å. Ag counterelectrodes deposited on top of the Al_2O_3 completed the junctions. The thickness of the Ag counterelectrode was <500 Å for all of the junctions studied. Current–voltage characteristics of the junctions were measured while the junctions were in the proton beam. The current–voltage curves were approximately linear, showing a net electron current from the Ag electrode to the Al electrode at zero bias, and zero electron current when the Al electrode was biased from 2.1 to 4.75 V negative with respect to the Ag electrode. Proton beam currents ranged from 5×10^{-10} to 2×10^{-11} A. Proton energies ranged from 26 to 102 keV. Results are interpreted in terms of a model in which the insulating film is represented by a potential barrier separating a sea of electrons on either side of the barrier. Conduction takes place by passage of excited electrons across the top of the barrier. The effect of the bias is to modify the internal electric field in the oxide and to shift the momentum distribution of the excited electrons. Time-dependent effects in the current–voltage curves are observed which are believed to arise from charging of the oxide by the proton beam. (auth)

51793 TEMPERATURE DEPENDENCE OF γ-IRRADIATION HARDENING IN NaCl. Lerma, I. S.; Agullo-Lopez, F. (Junta de Energia Nuclear, Madrid). J. Appl. Phys.; 41: 4628-31 (Oct 1970).

It has been shown that the γ-radiation-induced hardening of NaCl is strongly dependent on temperature (between liquid-nitrogen temperature and room temperature) for low irradiation

doses, but it is essentially independent of it for doses $\gtrsim 6 \times 10^6$ R. For very low doses $\lesssim 1 \times 10^6$ R, the experimental data can be analyzed in terms of a rapid solution hardening mechanism of the type proposed by Fleischer. For higher doses, this model is not adequate and one should think of a precipitation (Orowan) hardening mechanism. (auth)

51794 COMMENTS CONCERNING THE ELECTRON PARAMAGNETIC RESONANCE IDENTIFICATION OF A DEFECT IN X-IRRADIATED SODIUM AZIDE. Gelerinter, Edward (Kent State Univ., Ohio). J. Chem. Phys.; 53: 2991-2(1 Oct 1970).

An EPR identification of an N_2^- defect in x-irradiated sodium azide was carried out by the authors at 2 to 4°K (J. Chem. Phys., 45: 1703(1966)). The spectra were interpreted in terms of a Jahn–Teller distortion from the normal trigonal symmetry about the azide site, with a tilt of 4.6° of g tensor from the c-axis. These results are reinterpreted in the light of structural studies, which found a phase change from rhombohedral to monoclinic below room temperature. Complications caused by twinning in the crystals are also considered. Both models are consistent with the identification of the defect as an N_2^- ion in the azide site. Possible studies to resolve the question of which model is correct are suggested. (D.L.C.)

51795 PHOTOCONDUCTIVITY OF NEUTRON-IRRADIATED GALLIUM ARSENIDE. Borghi, L.; De Stefano, P.; Mascheretti, P. (Univ., Pavia, Italy). J. Appl. Phys.; 41: 4665-8(Oct 1970).

Photoconductivity spectra taken on fast-neutron-irradiated samples of GaAs show a structure that is interpreted as being due to transitions between energy levels and either the valence or the conduction band. Levels lie at approximately 0.2 and 0.7 eV above the valence band and 0.5 eV below the conduction band. Slow-neutron irradiation was employed to compensate the acceptor impurity in p-type GaAs. A level at $E_v + 0.7$ eV is detected in the high-resistivity material thus obtained. It is concluded that such level is associated with a defect that is present in GaAs before irradiation in an inactive form. (auth)

51796 ELECTRON PARAMAGNETIC RESONANCE ASSOCIATED WITH Zn VACANCIES IN NEUTRON-IRRADIATED ZnO. Taylor, A. L.; Filipovich, G.; Lindeberg, G. K. (3M Co., St. Paul, Minn.). Solid State Commun.; 8: 1359-61(1970).

Lines in the EPR spectrum of ZnO crystals irradiated by 3.6×10^{18} cm^{-2} fast neutrons are ascribed to holes on oxygen atoms in the basal plane of O_4 tetrahedra which surround Zn vacancies. (auth) (UK)

51797 EFFECTS OF SELF-IONIZATION OF β-ACTIVE ELEMENTS IN NONMETALS. Smoluchowski, R. (Princeton Univ., N. J. Sandia Labs., Livermore, Calif.); Wilson, W. D. Phys. Rev., B; 2: 2243-50(15 Sep 1970).

A new mechanism is proposed for the formation of stable substitutional or interstitial diatomic molecules in nonmetallic crystals in which self-ionization of β-active ions occurs. In particular, the probability of self-ionization of tritium ions in LiT and LiH : LiT crystals due to "shake-off" following β decay is calculated. It is found that the probability of obtaining a He^{2+} ion is 0.05, and for a He^+ ion 0.32, and that the presence of these ions can lead directly to the formation of hydrogen molecules without diffusion. Using a model of LiH which includes noncentral forces, the energetics of this process, which is essentially temperature-independent, and the rates of formation of hydrogen molecules are calculated. If, as experiments suggest, H^0 and H_2^- are indeed absent in irradiated LiH, then the formation of H_2 molecules (which accounts for the initial stage of swelling of LiH : LiT) is diffusion-controlled above 200 to 300°K but is due to the "shake-off" mode at lower temperatures. (auth)

51798 ESR OF Pb^{3+} CENTERS IN ThO_2. Kolopus, J. L.; Finch, C. B.; Abraham, M. M. (Oak Ridge National Lab., Tenn.). Phys. Rev., B; 2: 2040-2(15 Sep 1970).

Spectra of Pb^{3+} in sites having cubic and axial symmetry were identified in ThO_2 crystals grown from a PbF_2-based solvent that had been irradiated with electrons or γ rays. That part of the spectra arising from the 20%-abundant ^{207}Pb isotope ($I = 1/2$) is characterized by a large zero-field hyperfine splitting. The Pb^{3+} center with ⟨111⟩ axial symmetry shows a superhyperfine interaction with a ^{19}F nucleus. Part of this spectrum has previously been attributed to the F center in ThO_2. After exposure to ionizing radiation, no centers were detected in ThO_2 crystals grown from a $Li_2O \cdot 2WO_3$-based flux. Neutron irradiation of all crystals produced another center with ⟨100⟩ axial symmetry. (auth)

51799 X-RAY PLASMON SCATTERING. I. EXPERIMENT ON BERYLLIUM. Suzuki, Tadasu; Tanokura, Atsusi (Sophia Univ., Tokyo). J. Phys. Soc. Jap.; 29: 972-8(Oct 1970).

A crystalline beryllium specimen was used to confirm the excitation of plasma oscillation by x rays by examining the inelastic scattering for chromium $K\beta_1$ and copper $K\beta_1$ rays at various observation angles. The x rays suffered an energy loss equal to the plasmon energy of the solid and also satisfied the dispersion relation predicted by the free electron gas theory. The inelastic scattering was still observed beyond the critical angle estimated by the theory. At lower scattering angles the spectral breadth of the scattering was about 4 eV, which corresponds to the plasmon life time of 1.5×10^{-16} sec. As the angle was increased the breadth rapidly broadened and the scattering gradually disappeared. (auth)

51800 ANALYSIS OF Rb AND Cs IMPLANTATIONS IN SILICON BY CHANNELING AND HALL EFFECT MEASUREMENTS. Meyer, O.; Mayer, J. W. (California Inst. of Tech., Pasadena). Solid-State Electron.; 13: 1357-62(Oct 1970).

Analyses of silicon samples implanted with 5 to 50 keV Rb and Cs ions at substrate temperatures of 350°C and room temperature (R.T.) were made by use of Hall effect and sheet resistivity measurements and channeling techniques. Within limits of detection ($\lesssim 10\%$), neither Rb nor Cs was found to occupy substitutional or tetrahedral interstitial lattice sites. This behavior seems to be independent of implantation or anneal temperature. Outdiffusion effects were observed for both species. In Hall effect measurements on R. T. implanted samples, the number of carriers/cm^2, N_s, exhibited an increase at temperatures significantly above that where the lattice reordered and a decrease below that where outdiffusion started. The maximum value in the average carrier concentration was about 5×10^{18}/cm^3 for Rb and 10^{18}/cm^3 for Cs. In almost every respect the behavior of Cs and Rb-implanted samples differed from that found for Group II, III, V, and VI implanted species. (auth) (UK)

51801 INCREASE OF THE YIELD IN CHANNELING EXPERIMENTS. Kumakhov, M. A. (Moscow State Univ.). Phys. Lett.; 32A: 538-9(7 Sep 1970).

It is shown that backscattering experiments make it possible to find the exact location of impurity and displaced atoms. When the impurity atom is localized in the center of a channel, the yield increases. (auth)

51802 TEMPERATURE DEPENDENCE OF THE CARRIER GENERATION YIELD IN ELECTRON-BOMBARDED ANTHRACENE. Sansal, B. (Institut d'Etudes Nucleaires, Algiers); Schott, M. Solid State Commun.; 8: 1499-1501(15 Sep 1970).

This yield was measured using 40-keV electrons and clearing fields E up to 10^4 V/cm between 140 and 320°K. It is at most very weakly increasing with E, and is proportional to T in the whole range. This behavior is expected for a yield limited by bimolecular recombination in the excited spurs. The average radius of a spur must be $\lesssim 160$ Å. The electron drift mobility is 0.37 ± 0.02 cm^2/Vsec in the whole T range. (auth) (UK)

51803 THERMOLUMINESCENCE IN POLYETHYLENE. II. DOSE KINETICS. Boustead, I. (Royal Military Coll. of Science, Shrivenham, Eng.). Proc. Roy. Soc. (London), Ser. A; 318: 459-71(22 Sep 1970).

The dose dependence of thermoluminescence output from low- and high-density polyethylene is reported. Using a simple electron–ion recombination model of thermoluminescence, it is shown that dose kinetics measure the rate of trapping of electrons and quantitative expressions are derived for a number of simple trapping conditions. Using earlier identifications of the electron traps in polyethylene, the experimental observations are shown to be in agreement with the theoretical equations. It is also shown that, at low doses, the characteristic glow curve of polyethylene is supplemented by an emission probably arising from some form of electron–radical interaction. (auth) (UK)

51804 DIELECTRIC CALCULATION OF ENERGY LOSS TO VALENCE ELECTRONS UNDER CHANNELING CONDITIONS. Bonsignori, F.; DeSalvo, A. (Univ., Bologna. Istituto Nazionale di Fisica Nucleare, Bologna. CNR, Bologna). J. Phys. Chem. Solids; 31: 2191-8(Oct 1970).

The decrease in the contribution of valence electrons to the stopping power under channeling conditions has been evaluated by taking into account the Fourier components with $G \neq 0$ of the response function: explicit calculations were carried out in the weak-binding limit. The particular case of 100-keV protons travelling at the center of [001] channel in gold has been calculated in detail. The decrease in the valence electron contribution to the stopping power in channeling, turns out to be much smaller than the decrease of local electron density at midchannel axis. These results are in reasonable agreement with the experimental ones obtained in this laboratory. (auth) (UK)

51805 ESR SPECTRA OF SODIUM–TITANIUM–SILICATE GLASSES AND OF TITANIUM-CONTAINING OXIDE COMPOUNDS.

Boehm, H.; Bayer, G. (Technische Hochschule, Zurich). J. Phys. Chem. Solids; 31: 2125-37(Sep 1970).

The formation of trivalent titanium in glasses and its dependence on chemical composition, temperature, atmosphere, and irradiation were studied by means of ESR. For comparison and assignment of the resonances, several crystalline titanium-containing oxide compounds were also investigated after slight reduction at 600°C in hydrogen. (auth) (UK)

51806 DECAY TIME OF THE FLUORESCENCE OF URANYL NITRATE ACCORDING TO THE τ-PHASOMETER METHOD. Pohoski, R.; Zachara, S. (Paedagogische Hochschule, Danzig). Z. Naturforsch., 25a: 446-7(Mar 1970). (In German).

The decay time of uranyl nitrate was measured with a 100 cycle/sec phase fluorometer. Excitation occurred through a xenon lamp with monochromator. Results showed that the decay time is constant throughout the entire emission range and independent of excitation energy. It was concluded that, therefore, the entire fluorescence emission originates in one center. Discrepancy of findings with those obtained by other investigators was explained by differences in excitation intensities. (H.B.G.)

51807 PROPAGATION OF DISLOCATIONS IN NEUTRON-IRRADIATED CALCIUM FLUORIDE SINGLE CRYSTALS. Patel, A. R.; Desai, C. C. (Sardar Patel Univ., Gujarat, India). Indian J. Pure Appl. Phys.; 7: 562-4(Aug 1969).

Single-crystal cleavages of natural calcium fluoride were irradiated with thermal and pile neutrons, the flux varying from 1.3×10^{4} to 3.0×10^{13} n/cm^2. The change in the hardness of the irradiated crystals was determined using Vicker's microhardness tester. The lengths of the rays of stars produced in the etch figure around the indentation, obtained by etching the indented cleavages, were measured. It is observed that the microhardness of irradiated crystals changes when irradiated with neutrons. The microhardness at different depths within the body of the irradiated crystals was measured, and it was observed that the hardness increases as one moves within the body of the crystal. The implications are discussed. (auth)

51808 INFLUENCE OF NEUTRON IRRADIATION ON THE CHARACTERISTIC QUANTITIES OF THE ALLOYED SEMICONDUCTOR GeSi. Macko, P. (Slovak Technical Univ., Bratislava). Fyz. Cas.; 20: No. 1, 36-47(1970).

Samples of n-type GeSi were exposed to 1×10^{16}, 1×10^{17}, 5×10^{17}, and 1×10^{18} n.cm^{-2} of fast neutrons at 300°K. To investigate the changes due to radiation damage, measurements were performed of conductivity, of the Seebeck coefficient, of thermal conductivity, and of the Z parameter in the temperature range between 100 and 400°K. Graphs of temperature and flux dependences are presented, and simple theoretical expressions are derived that are in good agreement with the experiment. A negative influence of neutron irradiation on all investigated parameters was found. The changes begin to show when the concentration of defects due to irradiation exceeds the concentration of inherent defects. (INIS)

51809 EFFECT OF THE β RADIATION OF TRITIUM ON LUMINESCENCE AND ENERGY TRANSFER IN ANTHRACENE. Doronina, V. I.; Konobeev, Yu. V.; Khan-Magometova, Sh. D. Opt. Spectrosc. (USSR) (Engl. Transl.); 28: 436-7(Apr 1970).

Translated from Opt. Spektrosk.; 28: 811-13(Apr 1970).

In a previous study (Opt. Spectrosc. (USSR)(Engl. Transl.) 16: 457 (1964)) of luminescence of anthracene crystals exposed to tritium β-electrons, the luminescence decreases with dose owing to exciton quenching. This can be explained by assuming multiple luminescence light reflection from the inner surfaces of the crystals, and a study is made of the reabsorption and reflection of light from the crystal faces on the basis of a kinetic equation. Relative luminescence yields are calculated for the maximum dose for the cases of reflection and no reflection; a plot of yield vs crystal depth shows that the experimental data fall between the two calculated curves. (D.L.C.)

51810 LUMINESCENCE OF KCl–Eu CRYSTALS. Begak, O. Yu.; Avdonin, V. P.; Plachenov, B. T. Opt. Spectrosc. (USSR) (Engl. Transl.); 28: 442-3(Apr 1970).

Translated from Opt. Spektrosk.; 28: 820-2(Apr 1970).

A study was made of the abnormally high activator luminescence yield of KCl–Eu crystals in the temperature region 500 to 600°K. This effect was determined to be associated with the Eu concentration, and it is hypothesized that associations of Eu ions and cation vacancies are dissociated at high temperatures to increase the number of luminescence centers. The effects of chilling on the photoluminescence and radioluminescence yields support this hypothesis. (D.L.C.)

51811 OPTICAL DETECTION OF SURFACE DAMAGE IN GaAs INDUCED BY ARGON ION IMPLANTATION. Sell, D. D.; MacRae, A. U. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys.; 41: 4929-32(Nov 1970).

Surface damage in GaAs was studied by measuring the room-temperature reflectance in the 3-eV spectral region. Controlled levels of damage were created by implanting samples with known doses of 75-keV argon ions. The damage from doses as low as 10^{11} ions/cm^2 was observed by studying the energy derivative of the reflectance (dR/dE)/R. As the damage level is increased, the optical reflectance structure broadens and hence the amplitude of (dR/dE)/R decreases. The sensitivity of this technique is comparable to or greater than that obtainable with other damage measurement techniques. The results for three other techniques (ellipsometry, channeling, and photoluminescence) are briefly discussed. Possible applications of the reflectance method are considered. (auth)

51812 COLOR CENTERS AND THE THERMOLUMINESCENCE MECHANISM IN LiF. Mayhugh, M. R. (Dartmouth Coll., Hanover, N. H.). J. Appl. Phys.; 41: 4776-82(Nov 1970).

Color-center transformations in pure and dosimetry-grade LiF were studied over the wavelength range 105 to 750 nm. Both impurity- and irradiation-induced optical absorption were measured, the latter by a relatively high x-ray exposure at room temperature. Thermal and optical treatments were chosen to induce transformations that are easily related to the thermoluminescence (TL) process. The results demonstrate the following for dosimetry LiF: The TL-associated 310-nm absorption results from trapped electrons. The TL process intimately involves V_3 centers (113-nm absorption band). The centers causing the 225-nm band (Z_3 band) and those causing the 137-nm impurity band may both be involved in the sensitization (and supralinearity) phenomenon. A complete model for the TL is presented and discussed. Not so important to the TL is a broad apparently intrinsic absorption from 120 to 200 nm which is induced by irradiation in both pure and dosimetry LiF. (auth)

51813 BETA- AND GAMMA-INDUCED CONDUCTIVITY IN SEMICONDUCTORS: APPLICATION TO CdS NEUTRON DETECTORS. Johnson, Ralph T. Jr. (Sandia Labs., Albuquerque, N. Mex.). J. Appl. Phys.; 41: 4981-91(Nov 1970).

Methods for determining the mobility–lifetime ($\mu\tau$) product of high-resistivity n- or p-type semiconductors, using induced conductivity resulting from high-energy beta and gamma irradiations, are developed. The $\mu\tau$ product is determined, under conditions of steady-state excitation, from the measured induced conductivity and the calculated electron–hole generation rate g. The carrier-free lifetime τ is determined from these results using the measured Hall mobility. For gamma irradiation, g is determined from the exposure rate, density, mass energy-absorption coefficients, and radiation-ionization energy (ϵ). For beta irradiation, g^{β} is determined for the case of ionization resulting from the beta decay of radioisotopes that are produced by neutron irradiation and that are randomly distributed throughout the semiconductor. g^{β} is determined from the radioactive decay rate, energy of the beta radiation, and ϵ. The absorbed dose rates resulting from these radiations are also determined. Gamma-induced conductivity experiments were performed using ^{60}Co gamma irradiation on high-resistivity n-type CdS, CdSe, GaAs, and ZnS single crystals. The measured $\mu\tau$ products ranged from $\sim 10^{-5}$ to 25 cm^2/V; τ varied from $\sim 10^{-8}$ to 10^{-1} sec. Some reduction in $\mu\tau$ resulting from high-temperature annealing of CdS and GaAs was also observed. Beta- and gamma-induced conductivity experiments (^{32}P beta decay and ^{60}Co gamma irradiation) were performed on neutron-irradiated CdS single crystals. Comparison of these results show that: (1) The $\mu\tau$ products determined at a given dose rate from the beta and gamma irradiations are in very good agreement (within 15%). Thus, the theories developed for determining g and g^{β} are valid. (2) For samples which have considerable neutron damage, $\mu\tau$ is very dependent upon exposure rate (or absorbed dose rate), decreasing with increasing exposure rate. This is in contrast to samples which have minimal (or no) neutron damage, where very little dependence on exposure rate is observed. (3) The $\mu\tau$ product is also dependent upon the conductivity or Fermi level position. For irradiated high-resistivity crystals $\mu\tau$ is 1 to 6 cm^2/V, and τ is of the order of tens of msec. However, for irradiated low-resistivity crystals $\mu\tau$ is larger by a factor of $\sim 10^3$, and τ is of the order of seconds. The dependence of $\mu\tau$ on the excitation intensity, defect concentration, and Fermi level position in neutron-damaged samples results from sensitizing centers associated with neutron-induced defects. The concepts developed here have resulted in new techniques for measuring neutron fluences using electrical changes associated with induced radioactivity in semiconductors. Gamma-induced conductivity provides a valuable technique for "calibrating" these detectors (i.e., determining the $\mu\tau$ product). (auth)

51814 EPR STUDY OF NUCLEAR RADIATION EFFECTS IN $CaWO_4$. Kikuchi, Chihiro; Mason, David R. (Univ. of Michigan, Ann Arbor). pp 227-46 of Magnetic Resonance. /Coogan, C. K. (ed.). New York; Plenum Publishing Corp. (1970).

From International Symposium on Electron and Nuclear Magnetic Resonance, Melbourne, Australia. See CONF-690839.

Studies were carried out on the EPR centers produced by neutrons and gamma rays in order to determine the impurity and defect structure of $CaWO_4$. Paramagnetic W^{5+} centers were identified, and the V^{4+}, Nb^{4+}, and Ta^{4+} centers produced by gamma irradiation were studied. Positive identification of thermoluminescent centers in nominally pure $CaWO_4$ was made. (D.L.C.)

Physical Properties

Refer also to abstracts 50362, 51214, 51223, 51564, and 52377.

51815 (CONF-690916-(Vol.1), pp 98-103) NEUTRON SCATTERING AS A TOOL IN THE STUDY OF MAGNETIC MATERIALS. Murthy, N. S. Satya (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23-26, 1969. Vol. I.

Tabular structural data are presented for pure ferrites, mixed ferrites, and alloys of NiAs type ($Fe_{1.67}Ge$, $Mn_{1.74}Sn$, and $Fe_{1.02}Mn_{0.98}Ge$) that resulted from scattering studies of polarized thermal neutrons. Brief comments are also given from studies on the magnetic properties of Heusler alloys, but no tabular data are included. (L.M.T.)

51816 (UCRL-19647) POSITRON ANNIHILATION IN METALS AT VERY HIGH PRESSURES. Przybylinski, John L. (California Univ., Berkeley. Lawrence Radiation Lab.). Aug 1970. Contract W-7405-eng-48. 127p. Dep. NTIS.

Thesis.

The angular correlation of gamma rays from positrons annihilating with electrons in metals can be used to study the momentum distribution of conduction electrons in a metal. This method was used in the study of three metals, aluminum, bismuth, and ytterbium, at pressures up to 100 kilobars. Aluminum yielded unexpected and only partially explained results, which are thought to be associated with the state of strain of the aluminum specimen. The bismuth results were in agreement with the Free Electron Model. The results on ytterbium provided the first confirmatory evidence of a proposed promotion of an electron from a 4f state to a 5d conduction band at high pressures. Surprisingly, the promotion appears to take place before the phase transition from fcc to bcc at 40 kbar. Ytterbium in the fcc phase above 20 kbars, therefore, cannot be considered to be a semiconductor unless the 5d electrons are considered as core electrons for the purpose of conductivity. The Moessbauer effect of ^{161}Dy in gadolinium metal at very high pressures was measured. The experiment failed to confirm earlier work on the same system by Stone. However, it was consistent with work in other laboratories on similar systems. The resistance of crystalline phosphorous was carefully measured from 60 to 130 kbar. These measurements indicated that the phase transition from rhombohedral to simple cubic, which was reported by Jamieson to occur at 111 ± 9 kbar, does not occur below 130 kbar on the pressure scale used here. (auth)

51817 MAGNETIC PROPERTIES OF $TbIn_3$, $TbPt_3$, AND $HoIn_3$. Nereson, Norris; Arnold, George (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys.; 53: 2818-23(1 Oct 1970).

Neutron-diffraction measurements made on powder samples of $TbIn_3$, $TbPt_3$, and $HoIn_3$ show that all of these compounds exhibit antiferromagnetism below Néel temperatures of 37 ± 1°K, 20.5 ± 0.5°K, and 11.5 ± 0.5°K, respectively. The magnetic reflections from $TbPt_3$ can be indexed on a doubled chemical cell of cubic symmetry. A possible magnetic model consists of an arrangement where the Tb moments are aligned in opposite directions in adjacent (111) magnetic planes. The magnetic reflections from $TbIn_3$ and $HoIn_3$ can be indexed on a doubled chemical cell of tetragonal symmetry. An appropriate magnetic arrangement is one in which the rare-earth moments are aligned in opposite directions in adjacent (110) magnetic planes. For $TbIn_3$ the moment direction makes an angle of 10 ± 5° with the unique or c axis of the magnetic cell; for $HoIn_3$ the corresponding moment direction is 58 ± 5°. The saturation ordered moment on the rare-earth atom sites in all three compounds is approximately 10% less than the calculated or expected values. The magnetic structures are compared with predictions of the indirect exchange theory. (auth)

51818 SMALL-ANGLE CRITICAL SCATTERING OF NEUTRONS BY NICKEL. Maier, G.; Stump, N. (Institut fuer Festkoerperforschung, Juelich, Ger.). Z. Phys.; 238: 389-98(1970).

The critical magnetic scattering of neutrons by nickel was studied as a function of temperature and of the scattering vector κ in the range 0.008-0.04 $Å^{-1}$ for various specimens ranging from a single crystal to heavily deformed polycrystals. The shift of the temperature where the maximum of the scattered intensity is found as a function of scattering vector κ depends on the degree of crystalline imperfection. For the single crystal, the observed shift is $\Delta T/T \lesssim 5 \times 10^{-3}$. On the basis of the Ornstein-Zernike theory, the observed scattering by the single crystal yields the critical index $\gamma = 2\nu = 1.32^{+0.10}_{-0.14}$ as predicted by most of the theories. (auth)

51819 MAGNETOSTRICTION OF PARAMAGNETIC TRANSITION METALS. I. GROUP 4: Ti AND Zr; GROUP 5: V, Nb, AND Ta; GROUP 6: Mo AND W. Fawcett, E. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., B; 2: 1604-13(15 Sep 1970).

The longitudinal magnetostriction of transition metals of groups 4, 5, and 6 was measured with a capacitance dilatometer at low temperature in fields up to 100 kOe. The resultant values of the logarithmic volume dependence of the magnetic susceptibility $\partial \ln\chi/\partial \ln V$ are Ti, −0.34; Zr, −1.6, V, 1.2; Nb, 1.7; Ta, 1.1; Mo, 14; W, 6.5. The contribution from the spin paramagnetism is obtained from the volume dependence of the density of states, which is estimated from the electronic Grüeneisen coefficient with a correction for the electron-phonon coupling. The resultant values of the volume dependence of the orbital susceptibility for V, Nb, and Ta are physically reasonable. The negative magnetostriction of Ti and Zr is not inconsistent with their thermal expansion, but the large positive magnetostriction of Mo and W is difficult to understand. The samples of Mo and W exhibit oscillatory de Haas-van Alphen magnetostriction at 4.2°K. (auth)

51820 LATTICE DYNAMICS OF BERYLLIUM FROM A FIRST-PRINCIPLES NONLOCAL PSEUDOPOTENTIAL APPROACH. King III, Walter F. (Technical Univ., Lyngby, Denmark); Cutler, P. H. Phys. Rev., B: 2: 1733-42(15 Sep 1970).

The lattice dynamics of beryllium, a metal with hexagonal close-packed structure and two atoms per unit cell, is investigated within the framework of Harrison's first-principles pseudopotential theory, using (i) the Slater approximation for the conduction-band-core exchange, and (ii) a modified dielectric-screening function employing the Kohn-Sham approximation for exchange among the conduction electrons. The energy-wave-number characteristic F(q) is constructed from the Hartree-Fock-Slater (HFS) wave function for Be^{2+}; this is used to calculate the phonon dispersion relations in the [0001], [01$\bar{1}$0], and [11$\bar{2}$0] directions. Good agreement is obtained with neutron-diffraction experiments. The three independent elastic shear constants are also calculated from F(q); good agreement with experiment is obtained for C and C', but only fair results obtain for c_{44}. (auth)

51821 ELECTRICAL RESISTIVITY AND THERMOELECTRIC POWER OF POLYCRYSTALLINE URANIUM AT ELEVATED TEMPERATURES. Arajs, Sigurds; Flora, Robert H.; Anderson, Elmer E. (Clarkson Coll. of Tech., Potsdam, N. Y.). J. Nucl. Mater.; 37: 89-95(Oct 1970).

The electrical resistivity ρ(T), of high-purity uranium [ρ(3.67 °K) = 0.955 $\mu\Omega$cm] was studied as a function of temperature, T, between 295 and 1370 °K. Measurements were made on the absolute thermoelectric power, S_U(T), between 380 and 1000 °K. Crystal structure changes taking place at elevated temperatures cause anomalies in the ρ(T) vs T and S_U(T) vs T curves. The agreement between the ρ(T) data of different investigators is better for the α phase than for the β and γ phases. Large disagreements in S_U(T) among different investigations exist at elevated temperatures. The S_U(T) vs T curve of the present study joins smoothly the curve between 20 and 300 °K due to Meaden and Lee. The above-mentioned electrical transport properties are briefly discussed from the viewpoint of the electronic structure of uranium and the multiband conduction theory. (auth)

51822 PARAMAGNETIC RESONANCE OF Gd^{3+} IN INTERMETALLIC COMPOUNDS YAl_2. Schaefer, W. (Technische Hochschule, Darmstadt, Ger.); Schmidt, H. K.; Elschner, B.; Buschow, K. H. J. Phys. Lett.; 33A: 23-4(21 Sep 1970).

The paramagnetic resonance of Gd^{3+} in YAl_2 was measured in the temperature range from 5 to 70°K. The dependence of linewidth on temperature and Gd concentration indicates the existence of a "bottleneck" in the relaxation between the conduction electrons and the lattice. (auth)

51823 NUCLEAR-ORIENTATION MEASUREMENTS IN DILUTE AuCe. Flouquet, J. (Faculte des Sciences, Orsay, France); Marsh, D. Phys. Lett.; 32A: 501-2(7 Sep 1970).

Nuclear orientation of $^{131}Ce^{m}$ implanted in gold shows that Au-base-Ce alloys are magnetic. (auth)

51824 TEMPERATURE DEPENDENCE OF SPIN–PHONON RELAXATION TIME IN HOLMIUM. Lee, M. C.; Levy, M. (Univ. of California, Los Angeles). Phys. Lett.; 32A: 505-6 (7 Sep 1970).

A phenomenological calculation is given for the temperature dependence of the spin–phonon relaxation time in the spin–spiral phase of the heavy rare earth metals. It is found that, for a single crystal of holmium, the relaxation time decreases as T^{-3} when the temperature is increased. (auth)

51825 SECOND- AND THIRD-ORDER ELASTIC CONSTANTS OF Cr, Mo, AND W. Mathur, S. S.; Sharma, Y. P. (Indian Inst. of Tech., New Delhi). Phys. Status Solidi; 41: K51-5(1 Sep 1970).

The Morse potential was used to calculate the second- and third-order elastic constants, elastic anisotropy, and Debye temperature of Cr, Mo, and W. The interaction energy for a pair of atoms tends rapidly to zero after 116 atoms for W, after 140 atoms for Mo, and after 164 atoms for Cr; the elastic constants were computed for the region where the interaction energy becomes negligible. The results are compared with experimental and theoretical values of others. (D.L.C.)

51826 ELASTORESISTANCE OF β-RHOMBOHEDRAL BORON CRYSTALS. Fuhs, W. (Univ., Marburg, Ger.). Phys. Status Solidi; 41: K17-19(1 Sep 1970).

The longitudinal elastoresistance of β-rhombohedral B single crystals was measured between 180 and 500°K. Elastic deformation was produced by bending oscillations (6 Hz), and the resistance change $\Delta R/R$ was measured in the direction of the strain ϵ perpendicular to the c-axis. Above room temperature (RT), the conductivity σ follows the exponential law with $E_0 = 0.6$ eV. The elastoresistance $m = (1/\epsilon)\,\Delta R/R$ is positive; below RT it is constant and relatively small, while at higher temperatures, much larger values of m are found and m decreases with 1/T. When m is plotted logarithmically vs 1/T, approximately the same activation energy as for σ is found (0.6 eV). E_0 exhibits a weak dependence on strain, with $\Delta E_0/\epsilon = 0.4$ eV. Possible conduction mechanisms from these results are discussed. (D.L.C.)

51827 EFFECT OF CONCENTRATION GRADIENTS OF IMPURITIES ON THE TEMPERATURE DEPENDENCE OF THE SPIN–LATTICE RELAXATION TIME IN LITHIUM AND BERYLLIUM. Orchard-Webb, J. H.; Watts, A. J.; Smithard, M. A.; Cousins, J. E. (Univ. of Exeter, Eng.). Phys. Status Solidi; 41: 325-32(1 Sep 1970).

Measurements are presented of the conduction electron spin resonance linewidths for various samples of lithium and beryllium at frequencies of 9.27 GHz and 33 and 80 MHz, the samples having dimensions that are large compared to the appropriate skin depth. An increase in the linewidths and certain line shape anomalies, as measured at 9.27 GHz at low temperatures, are discussed in terms of relaxation in an impure surface layer. A value of $\chi_s = 1.6 \times 10^{-7}$ cgs units was deduced for the spin susceptibility of beryllium. (auth)

51828 LOW-TEMPERATURE SPECIFIC HEAT MEASUREMENTS OF SEMI-BORIDES OF THE FIRST SERIES OF TRANSITION ELEMENTS. Kuentzler, R. (Institut de Physique, Strasbourg). Phys. Status Solidi; 41: 291-6(1 Sep 1970).

The low-temperature specific heat of nineteen borides T_2B and their mixtures was measured between 1.2 and 4.2°K. The variation of the electronic specific heat coefficient γ as a function of the e/a ratio of the transition metal gives the shape of the 3d-band of T_2B. The band shape shows a minimum for the transition from weak to strong ferromagnetism. For the concentrations where the ferromagnetism appears and disappears, the γ values are strongly enhanced and do not express the real density of states at the Fermi level. The end of the T_2B band compared with that of transition metals is shifted to lower e/a values as a result of a transfer of electrons to the 3d-band due to the presence of boron atoms. (auth)

51829 LATTICE DISTORTION IN URANIUM DIOXIDE NEAR 30°K. Pirie, J. D.; Smith, T. (Univ. of Aberdeen, Scotland). Phys. Status Solidi; 41: 221-4(1 Sep 1970).

Uranium dioxide is an antiferromagnetic below 30.8°K. It has been suggested that there may be a displacement of the uranium ions associated with the magnetic phase transition. X-ray measurements show that, provided the antiferromagnetic domains are sufficiently large (several hundred Å), a possible uranium movement in the ⟨100⟩ direction is less than 0.0076 Å. (auth)

51830 ENERGY BANDS IN β'-PdIn. Cho, S. J. (National Research Council of Canada, Ottawa). Phys. Status Solidi; 41: 179-89(1 Sep 1970).

The energy bands for ordered β'-PdIn are calculated by the augmented-plane-wave (APW) method. The results are similar to those for β'-CuZn except near R. The theoretical extremal Fermi surface cross sections are reasonably in agreement with those obtained by the de Haas–van Alphen studies. The possible open orbits are also studied. The electronic density of states curve is obtained from the energy bands. The electronic specific heat coefficient, magnetic susceptibility, and cyclotron effective masses are also estimated. Comparisons are made between the results and optical data. (auth)

51831 DETERMINATION OF THE EFFECTIVE MASSES OF THE ELECTRON JACK, HOLE OCTAHEDRON, AND ELLIPSOIDS OF MOLYBDENUM BY CYCLOTRON RESONANCE MEASUREMENTS. Herrmann, R.; Krueger, H. (Humboldt Univ., Berlin). Phys. Status Solidi; 41: 99-106(1 Sep 1970).

The anisotropic behavior of the effective masses in the ⟨100⟩ plane in molybdenum was determined by cyclotron resonance measurements. Resonances from all parts of the Fermi surface were measured—electron jack, hole octahedron, and hole ellipsoids—with effective masses between $\mu = 3.9$ and $\mu = 0.4$. From the cutoff angles of the different resonances and the behavior of the corresponding effective masses as a function of the angle between the magnetic field and the [011] axis, conclusions could be drawn as to details of the Fermi surface. The mean velocity on the hole octahedron was estimated. The measurements were made at f = 9.25 GHz and T = 1.6°K, the vector of the high-frequency current being parallel to the [011] axis. (auth)

51832 CONDUCTIVITY MECHANISM OF β-RHOMBOHEDRAL BORON. Werheit, H.; Leis, H. G. (Univ., Cologne). Phys. Status Solidi; 41: 247-53(1 Sep 1970).

Electron- and hole-trapping levels of high density of states determine essentially the conductivity mechanism of β-rhombohedral boron. The ionization energy of trapped electrons is much greater than that of trapped holes; so, up to high temperatures, the electrons do not appreciably contribute to the charge transport. From electric conductivity and thermoelectric power at higher temperatures, one obtains the activation energy of the hole mobility (0.19 eV). At low temperatures, hopping within the hole trapping level seems to be the prevailing conductivity mechanism. (auth)

51833 EXTRACTING ACCURATE CYCLOTRON MASSES FROM WEAK DE HAAS–VAN ALPHEN BEAT PATTERNS. Everett, P. M. (Louisiana State Univ., Baton Rouge). Cryogenics; 10: 314-15(Aug 1970).

If the presence of the recessive oscillation in a weak de Haas–van Alphen beat pattern is ignored, the apparent value of the cyclotron mass of the dominant oscillation, obtained from the temperature dependence of the amplitude, oscillates in field with the period of the beat. The amplitude of this apparent mass oscillation is large enough to cause significant error if the mass is determined at only one field value. Under the appropriate experimental conditions this error can be eliminated by averaging the apparent mass values obtained at the node and the antinode of the beat pattern. (auth) (UK)

51834 RESISTIVITY CHANGES IN QUENCHED Cd. Sprusil, B.; Vostry, P.; Pametnicka, I. (Charles Univ., Prague). Phys. Status Solidi; 41: 425-30(1 Sep 1970).

Cadmium wires of purity 99.998 at. % were quenched from T_Q = 503 and 543°K to 78°K. Resistivity changes upon an isochronal and isothermal annealing were studied in the temperature range 78 to 430°K. In the specimens investigated, four recovery intervals were observed and in three of them recovery kinetics and activation energies were determined. The possible role of vacancies is discussed. (auth)

51835 HYPERFINE FIELDS AT ^{42}Ca IN FERROMAGNETIC METALS AND THE g FACTOR OF THE 3.19-MeV 6^+ STATE. Marmor, M.; Cochavi, S.; Fossan, D. B. (State Univ. of New York, Stony Brook). Phys. Rev. Lett.; 25: 1033-5(12 Oct 1970).

The hyperfine fields at Ca in ferromagnetic metals have been studied by time-differential measurements on the 3.19-MeV 6^+ state in ^{42}Ca. The observed hyperfine field in Fe was $H_{hf} = -100 \pm 9$ kG; preliminary results in Co indicated $H_{hf} = -70 \pm 15$ kG and in Ni suggested $|H_{hf}| < 30$ kG. These results are in disagreement with predictions by Balabanov and Delyagin. A time-integral measurement in an external magnetic field yielded $g(6^+) = -0.42 \pm 0.03$. The mean lifetime of the 6^+ state was remeasured to be $\tau = 7.65 \pm 0.23$ nsec. (auth)

51836 DE HAAS–VAN ALPHEN EFFECT IN DILUTE BERYLLIUM–COPPER ALLOYS. Goldstein, I. S.; Sellmyer, D. J.; Averbach, B. L. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., B; 2: 1442-51(15 Sep 1970).

The de Haas–van Alphen effect was investigated in pure beryllium and in Be–Cu alloys containing up to 0.34 at. % Cu. The

extremal cross-sectional areas of the cigar-shaped third-band electron pieces of Fermi surface decreased with alloying. The areas of the coronet-shaped second-band hole piece increased with alloying. The magnitude of the area changes were compared with rigid-band-theory predictions. Corrections for lattice-parameter changes were included when possible. In the low-concentration limit, the theory is able to account for the observed area changes. For the highest-concentration alloy, there are deviations, for all areas measured, to greater changes than are predicted by the theory. However, further data in the higher-concentration region (≳0.3 at.% copper) are needed to verify this trend. Amplitude measurements were made to obtain cyclotron masses and scattering temperatures. Within experimental error, the masses were found to be independent of alloying. A significant anisotropy over the Fermi surface was observed in the rate of change of scattering temperature with respect to copper concentration. An analysis was made to determine the scattering rate due to copper impurities for the four orbits studied. The results indicate that this scattering rate is considerably larger for the two cigar orbits than it is for the two coronet orbits. The relative values of the scattering times as determined by the de Haas–van Alphen effect and residual-resistivity measurements were compared with the free-electron theory of Brailsford. Only order-of-magnitude agreement was found. (auth)

51837 EFFECT OF ALLOYING ON THE FERMI SURFACE OF BERYLLIUM. Tripp, J. H.; Everett, P. M.; Fiske, J. M.; Gordon, W. L. (Case Western Reserve Univ., Cleveland). Phys. Rev., B; 2: 1556-63(15 Sep 1970).

The Fermi surfaces of some dilute (less than 1 at.%) alloys of beryllium with copper have been measured by the de Haas–van Alphen (dHvA) effect with an accuracy of about ½%. Some cyclotron masses have also been obtained. For comparison with experiment, the nonlocal-pseudopotential model for the Fermi surface of pure beryllium has been extended to include dilute random substitutional alloys. It is found that the changes in the Fermi surface arise principally from the shift of Fermi level and the lattice-spacing changes, while the effect of including explicitly the solute pseudopotential appears to be unimportant for these dilute alloys. The only adjustable parameter in each alloy is the Fermi level, and this is determined by fitting a single measured de Haas–van Alphen frequency. The model Fermi surface thus produced fits all the observed dHvA frequencies with an accuracy of about 1%, comparable with the accuracy of the pure-beryllium model. (auth)

51838 THEORY OF SOFT OPTIC MODES AND PHASE TRANSITIONS IN β-W STRUCTURE TRANSITION-METAL ALLOYS. Klein, Barry M. (New York Univ., Bronx. Naval Research Lab., Washington, D. C.); Birman, Joseph L. Phys. Rev. Lett.; 25: 1014-16(12 Oct 1970).

A calculation of the phonon frequencies of the β-W structure crystals shows that long-wavelength optic-mode instabilities occur. These are associated with a high density of electronic states in the transition-metal d bands. The $\Gamma_{15}^{(-)}$ and $\Gamma_{25}^{(-)}$ optic modes soften; these are consistent with a second-order structural phase transition. (auth)

51839 OPTICAL CONSTANTS OF CRYSTALS OF URANYL COMPOUNDS. Komyak, A. I.; Samodurov, V. P. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 6, 125-8(1969). (In Russian).

A variety of optical properties were observed for twelve artificially obtained crystals of uranyl compounds, using an immersion method and a polarizing microscope. Crystals of uranyl nitrates showed the largest double refraction, and crystals of uranyl chlorides the smallest. The variety of optical properties is determined by the structure of the coordination sphere of the uranyl ion and the location of molecules in the unit cell. (tr-auth)

51840 ORIENTATION EFFECTS IN THE RESISTIVITY OF Ta FILMS SPUTTERED IN OXYGEN. Westwood, W. D. (Northern Electric Research and Development Labs., Ottawa). Appl. Phys. Lett.; 17: 264-5(15 Sep 1970).

Tantalum films deposited by sputtering in an O–Ar mixture consist of the tetragonal β phase. As the flow rate of the mixture into the sputtering system increases, the preferred-growth orientation changes from (200) to (202) and the resistivity ρ increases from 265 to 1100 μΩ-cm. The value of $\Delta\rho/\Delta T$ decreases monotonically with increasing (202) orientation, suggesting that the electrical properties are due to the β-Ta phase rather than to intergrain tunneling. (auth)

51841 STRUCTURES AND MAGNETIC PROPERTIES OF THE PSEUDO-BINARY SYSTEMS $CeNi_2$–$CeCu_2$ AND $GdNi_2$–$GdCu_2$. Wallace, W. E.; Volkmann, T. V.; Craig, R. S. (Univ. of Pittsburgh). J. Phys. Chem. Solids; 31: 2185-90(Oct 1970).

The C15 (cubic Laves phase) structure exists over the range x = 0 to 0.35 in the ternary system $GdNi_{2-x}Cu_x$ and the orthorhombic $GdCu_2$ phase extends from x = 1.1 to 2.0. In contrast, the solubility of $CeCu_2$ in $CeNi_2$ is below the limit of detectability. The magnetic behavior of the Gd-containing ternaries based on $GdNi_2$ closely resembles that of $GdNi_2$. The susceptibility of $CeNi_2$ is very low compared to that expected for an assemblage of free Ce^{+3} ions. The ratio of expected to measured susceptibility is 3.5 at 300°K but rises to approximately 100 at 4.2°K. The susceptibility deficiency is too great to be ascribed solely to the effect of the crystal field, although this may be a contributing factor. Partial ionization into Ce^{+4} and spin compensation (Kondo effect) by the conduction electrons may also be involved. Below 30°K, $1/\chi$ varies at $T^{0.48}$ in keeping with the behavior expected if spin compensation were the dominant effect. (auth) (UK)

51842 MAGNETIC STRUCTURE OF U_3P_4 AND U_3As_4. Przystawa, J. (Univ., Wroclaw). J. Phys. Chem. Solids; 31: 2158-9 (Sep 1970).

Recent studies of magnetic properties of U_3P_4 and U_3As_4 powders have found that these compounds become ferromagnetic below T_c, and their paramagnetic and ferromagnetic moments per U ion were established. Buhrer (1969) made measurements on monocrystalline samples. He suggested that the ferromagnetism consists of three ferromagnetic sublattices with mutually perpendicular directions. The author applies symmetry to the problem of the magnetic structure and concludes that there are two possible ferromagnetic groups. However, from Buhrer's results, one is ruled out. (UK)

51843 FERROMAGNETIC ANISOTROPY OF ELECTROLYTIC LAYERS OF Ni–Fe–Mo AT LOW TEMPERATURES. Bursuc, I. D. (Univ. Al. I. Cuza, Iasi); Diaconu, I.; Cuciureanu, C. Thin Solid Films; 5: 297-302(May–June 1970). (In French).

Electrodeposited Ni–Fe–Mo thin films having thicknesses greater than 300 μ present approximately the same H_k, independently of the Mo concentration or temperature. At room temperature, H_k decreases with increasing thickness. At 80 °K, H_k changes with the thickness in the same sense, but more slowly. At low temperatures, H_k increases. This increase is stronger for the thinner films with a smaller concentration of Mo. (auth)

51844 INVESTIGATIONS OF THE CRYSTAL LATTICE AND ITS QUASI PARTICLES BY MEANS OF NEUTRONOGRAPHIC METHODS. Janik, Jerzy A. (Inst. of Nuclear Physics, Krakow. Jagiellonian Univ., Krakow). Nukleonika; 14: 1193-1213(1969).

The paper considers the crystal and magnetic lattice structure, and describes the neutron testing methods used in Polish centers. In the field of crystal dynamics involving molecular groups, Polish achievements in the investigations of phonon and torson excitations in these crystals are described. Finally, the studies in the field of magnetic lattices are reviewed, with special attention to investigations of Polish researchers problems related with spin waves in magnetics. 72 references. (auth)

51845 PHASE COMPOSITION AND CONDUCTIVITY OF SPUTTERED TANTALUM. Westwood, W. D.; Livermore, F. C. (Northern Electric R and D Labs., Ottawa. Microsystems International Ltd., Ottawa). Thin Solid Films; 5: 407-20(May–Jun 1970).

Tantalum films have been deposited on both glass and ceramic substrates by dc diode sputtering. While normal dynamic sputtering with grounded substrates produced β-Ta films with a resistivity ρ of 200 μΩ cm and a temperature coefficient of resistivity, α, of −50 ppm/°C, a substrate potential of −100 V produced bcc Ta films with ρ = 30 μΩ cm and α = 2100 ppm/°C. X-ray diffraction analysis shows that ρ increases and α decreases as the percentage of β-Ta in the films increases. The bcc Ta concentration is increased by the application of a negative bias, by an increase in the presputter time, and by sputtering in static argon. These results indicate that β-Ta is an impurity phase which is formed to accommodate impurities at levels higher than the solubility limit of the impurity in bcc Ta. (auth)

51846 LUMINESCENCE AND THERMOLUMINESCENCE OF DOPED ZrO_2. Bettinali, Carlo; Ferraresso, Gastone; Virtusoso, Giuseppe (Univ., Rome). Ric. Sci.; 39: 761-5 (Oct-Dec 1969).

The photoluminescence and thermoluminescence spectra of ZrO_2 doped with Ce, Nb, UO_2, Tl, or Pb ions are reported. Photoluminescence spectra are similar to that of the Ti^{+4} material in spectral distribution but vary greatly in intensity. Thermoluminescence spectra are always reduced in intensity with respect to that of ZrO_2(Ti) and, further, do not always include all the peaks of that material. It is suggested from these results that the emission center is the Ti^{+4} ion, which is always

present as an impurity. On this supposition, all the thermoluminescence peaks are related to those of ZrO_2(Ti) and then corrected for the variation of emission intensity. The results show only small real variation (with respect to ZrO_2(Ti)) and support our hypothesis of the relationship between thermoluminescence and structural defects in ZrO_2. (auth)

51847 RESISTIVE LAYERS FORMED BY ION IMPLANTTION INTO METAL FILMS. Perkins, J. G. (Univ. of Surrey, Guildford, Eng.); Collins, L. E. Thin Solid Films; 5: R59-62 (May-Jun 1970).

A study was made of the electrical properties of oxide layers on Ti and Al thin films (2000Å thick) after O_2^+ ion implantation at 50 to 100 keV. The current–voltage characteristics of the oxide layers showed ohmic conduction below 0.1 V and space-charge-limited conduction above. A strong $I \propto \exp V^{1/2}$ dependence was found, which is typical of dielectric films. The temperature dependence shows that the activation energy increases with temperature. It is concluded that oxygen ion implantation can produce high-resistivity layers on Al and Ti with conduction properties similar to those of semiconducting and dielectric films. (D.L.C.)

51848 ELECTRICAL PROPERTIES OF YTTERBIUM OXIDE FILMS. Jawalekar, S. R. (Indian Inst. of Tech., Bombay). Indian J. Pure Appl. Phys.; 7: 801-6(Dec 1969).

The mechanism of electrical conductivity in thin films of ytterbium oxide is investigated experimentally. Using the results of previously established theory, it is shown that in very thin (25-40 Å) films of ytterbium oxide, quantum mechanical process of tunnelling predominates. Schottky emission is shown to be the principal mechanism of current flow in slightly thicker (80-150 Å) oxide films. Space-charge-limited currents are observed in thick (200-1000 Å) oxide films. A large number of metals are used for the counter-electrode and pronounced rectification effect is noticed. S-type current-controlled negative resistance is observed in ac fields. This result indicates the potential value of ytterbium–ytterbium oxide–metal diodes for applications in microelectronics. (auth)

51849 DOMAIN-WALL PROCESSES IN $SmCo_5$ POWDERS. Zijlstra, H. (Philips Research Labs., Eindhoven, Netherlands). J. Appl. Phys.; 41: 4881-5(Nov 1970).

Measurements of minor loops of $SmCo_5$ powders revealed that wall motion is predominant in the magnetization process. A relation between the reversible susceptibility χ of the minor loops and the coercivity H_c was found, showing that the coercivity of the investigated material is determined by the pinning of domain walls, rather than nucleation. The relation $\chi H_c^2 = \text{const}$ was found in a wide range of coercivities obtained by aging of the material. The aging process is interpreted as a decrease of the density of pinning sites, each site retaining its pinning force. Hysteresis loops measured on single particles of a few microns size confirm these interpretations and allow for a refined model of pinned-wall coercivity of $SmCo_5$ powders. (auth)

Moessbauer Effects and NMR

Refer also to abstracts 50581, 50652, 52617, and 52618.

51850 MAGNETIC PROPERTIES AND NUCLEAR MAGNETIC RESONANCE OF CUBIC RCu_5 INTERMETALLIC COMPOUNDS. Buschow, K. H. J. (Philips Research Labs., Eindhoven, Netherlands); van Diepen, A. M.; de Wijn, H. W. J. Appl. Phys.; 41: 4609-12(Oct 1970).

The magnetic properties of the cubic RCu_5 compounds $TbCu_5$, $DyCu_5$, $HoCu_5$, $ErCu_5$, and $TmCu_5$ are reported for temperatures between 2.1 and 300°K. In the paramagnetic region, the susceptibility follows a Curie–Weiss law. The type of ordering at low temperatures changes with increasing atomic number from antiferromagnetic (R = Tb) to ferromagnetic (R = Ho, Er, Tm), while $DyCu_5$ is metamagnetic. The Knight shifts of the ^{63}Cu NMR in these compounds have been measured between 100 and 300°K. The results are discussed in terms of the Ruderman–Kittel–Kasuya–Yosida theory. (auth)

51851 EVIDENCE FOR LOCALIZED CHARACTER OF ELECTRONIC STRUCTURE IN VANADIUM BORIDES FROM ^{51}V NUCLEAR MAGNETIC RESONANCE. Barnes, R. G.; Creel, R. B.; Torgeson, D. R. (Ames Lab., Iowa). Solid State Commun.; 8: 1411-14(1970).

Measurements are reported to the Knight shift of the nuclear magnetic resonance of ^{51}V in the known intermetallic compounds of vanadium and boron, V_3B_2, VB, V_5B_6, V_3B_4, V_2B_3, and VB_2. The shifts are found to occur with four well-resolved distinct values that may be correlated with the four types of boron environment of vanadium which arises in these intermetallic compounds. This correlation suggests the possibility of treating the electronic structure of the borides in terms of a synthesis of the band structures of the basic structural units, i.e., those of vanadium metal, VB, and VB_2. (auth) (UK)

51852 NUCLEAR MAGNETIC RESONANCE IN THE DIBORIDES OF SCANDIUM AND YTTRIUM. Barnes, R. G.; Creel, R. B.; Torgeson, D. R. (Ames Lab., Iowa). J. Chem. Phys.; 53: 3762-3(1 Nov 1970).

NMR spectra were measured at 77 and 300°K for ^{11}B, ^{45}Sc, and ^{89}Y in ScB_2 and YB_2. A weak second-phase signal appears only in the ^{45}Sc spectrum of ScB_2. The Knight shifts are small and positive; no Knight shift anisotropy was detected. The 300°K spectra are summarized and compared with data for VB_2. (D.L.C.)

51853 HYPERFINE INTERACTION OF 5s–p SOLUTES IN FERROMAGNETIC GADOLINIUM. Pasternak, M. (Univ. of Illinois, Urbana). Phys. Lett.; 32A: 449-50(7 Sep 1970).

Moessbauer-effect measurements on ^{125}Te and ^{129}I impurities in gadolinium yield values of hyperfine fields $H_{hf} = -229$ kOe and -42 kOe, respectively. These values are in excellent agreement with Campbell's prediction of the systematics of H_{hf} for s–p solutes in Gd. (auth)

51854 ISOMER SHIFTS OF THE 145-keV TRANSITION IN ^{141}Pr. Groves, J. L.; Debrunner, P.; De Pasquali, G. (Univ. of Illinois, Urbana). Phys. Lett.; 33A: 51-2(21 Sep 1970).

Isomer shifts were observed in a Moessbauer scattering study of the 145-keV level in ^{141}Pr and an estimate was made of the difference in mean square charge radius, $\langle r^2 \rangle 1g_{\frac{9}{2}} - \langle r^2 \rangle 2d_{\frac{5}{2}} = -(8.3 \pm 2.5) \times 10^{-29}$ cm^2. (auth)

51855 PRESSURE VARIATION OF MOESSBAUER FRACTION FOR AN IMPURITY ATOM. Nandwani, S. S.; Puri, S. P. (Univ. of Roorkee, India). Phys. Status Solidi; 41: 199-205(1 Sep 1970).

The variation of "Moessbauer fraction" f with pressure of ^{57}Fe embedded as a dilute impurity in Ti, V, Ni, Cu, Mo, Pd, W, and Pt host lattices has been calculated by incorporating both the force constant change and the mass change at the site of the impurity. Comparison of the calculations with available experimental values of the slope gives definite evidence for the change of the force constant q'/q. The value of q'/q thus obtained is in agreement with that obtained from the variation of f with temperature for Fe in Cu, but not for Fe in V. (auth)

51856 LINE SHAPE OF MOESSBAUER HYPERFINE SPECTRA. Schwegler, H. (Technische Hochschule, Darmstadt, Ger.). Phys. Status Solidi; 41: 353-67(1 Sep 1970).

A general theory of the line shape of Moessbauer hyperfine spectra is developed within the framework of a new operator space formulation and applied in the paramagnetic region. The phenomenological Wickman equations are derived from a microscopic quantum mechanical starting point. Explicit expressions for the relaxation terms are obtained, which make possible their discussion and evaluation and a comparison of Moessbauer results with the results of other measurements, especially those of the longitudinal susceptibility $\chi_{||}$. It is suggested that the discrepancies so far reported between Moessbauer and paramagnetic relaxation experiments are caused by the use of concentrated samples in the latter case. (auth)

51857 ^{11}B SPIN–LATTICE RELAXATION TIMES IN TRANSITION METAL DIBORIDES. Creel, R. B.; Barnes, R. G. (Ames Lab., Iowa). Phys. Status Solidi; 41: K27-9(1 Sep 1970).

NMR measurements were carried out using the tone-burst method, with the ^{11}B quadrupole interaction being taken into account. The experimental results for the ^{11}B nuclear spin-lattice relaxation times T_1 at 300°K are: TiB_2, 17.5 sec; VB_2, 2.7; CoB_2, 0.14, ZrB_2, 3.1; NbB_2, 0.8; MoB_2, 5.0; and TaB_2, 1.3. (D.L.C.)

51858 HIGH-RESOLUTION NMR IN SOLIDS. Mansfield, P. (Univ. of Nottingham, Eng.). Phys. Lett.; 32A: 485-6(7 Sep 1970).

A new four-pulse 6τ cycle is described that promises to be more efficient at line narrowing than previous cycles of equal or lower rank. (auth)

51859 EFFECTS OF RIGIDITY AND DENSITY ON THE TEMPERATURE VARIATION OF MOESSBAUER EFFECT. Srivastava, B. N.; Tyagi, R. N. (D.S.B. Government Coll., Naini Tal, India). J. Phys. Chem. Solids; 31: 2154-7(Sep 1970).

The modulus of rigidity and the density of solids are two strongly temperature-dependent parameters. These two parameters have been shown to be involved in the recoilless resonance emission of γ-rays. Through these parameters, the influence of temperature

on the recoilless fraction, f, has been calculated for the 14.4-keV transition of ^{57}Fe in some host lattices in the region of low ($T \ll \theta_D$) and high ($T \gg \frac{1}{2}\theta_D$) temperatures. (UK)

51860 MAGNETIC RESONANCE. Proceedings of the International Symposium on Electron and Nuclear Magnetic Resonance Held in Melbourne, August 11–15, 1969. Coogan, C. K.; Ham, Norman S.; Stuart, S. N.; Pilbrow, J. R.; Wilson, G. V. H. (eds.). New York; Plenum Publishing Corporation (1970). 395p. $16.00. (CONF-690839).

A total of 19 papers are included which treat novel problems in magnetic resonance. Topics covered are: NMR, quadrupole resonance, charge distributions, non-cubic metals, alkali metals, spin-lattice relaxation, line shape, NMR of rapidly rotating solids, spin-flip, ESR and ENDOR, $CaWO_4$, free radicals, carbon-13, neumatic liquid crystal solvents, and nuclidic mass and isotopic abundance measurement. Separate abstracts were prepared for five of the papers. (D.L.C.)

For abstracts of individual papers see: 51814 and 51861–51864.

51861 NUCLEAR MAGNETIC RESONANCE IN THE NONCUBIC METALS. Barnes, R. G. (Iowa State Univ., Ames). pp 63-90 of Magnetic Resonance. /Coogen, C. K. (ed.). New York; Plenum Publishing Corp. (1970).

From International Symposium on Electron and Nuclear Magnetic Resonance, Melbourne, Australia. See CONF-690839.

Recent developments in NMR experimental techniques that are useful for studying noncubic metals are summarized. A review is presented of the NMR studies of noncubic metals; Knight shifts are listed, and the problems of quadrupole interactions and electric field gradient inhomogeneity are considered. The noncubic metals in which NMR has not been detected are listed. (68 references) (D.L.C.)

51862 INFORMATION THEORY OF LINE SHAPE IN NUCLEAR MAGNETIC RESONANCE. Powles, J. G. (Univ. of Kent, Canterbury, Eng.); Carazza, B. pp 133-61 of Magnetic Resonance. /Coogan, C. K. (ed.). New York; Plenum Publishing Corp. (1970).

From International Symposium on Electron and Nuclear Magnetic Resonance, Melbourne, Australia. See CONF-690839.

A method is described for finding the actual line shape of an absorption line, or the Bloch decay, in nuclear magnetic resonance, given only a limited number of moments of the line. The line shape found is the most probable one, given the information available. If only the second moment is known, for example, the most probable line shape is gaussian. The method is shown to be useful in a number of particular cases such as the classic problem of the line shape in calcium fluoride, the broadened pair line shape, and "powder" line shapes. The method is capable of systematic improvement and gives further insight into the meaning of the line shape as a whole, as opposed to its moments, and uses information that is readily available but that is now commonly discarded. (auth)

51863 NUCLEAR MAGNETIC RESONANCE IN RAPIDLY ROTATING SOLIDS. Andrew, E. R. (Univ. of Nottingham, Eng.). pp 163-76 of Magnetic Resonance. /Coogan, C. K. (ed.). New York; Plenum Publishing Corp. (1970).

From International Symposium on Electron and Nuclear Magnetic Resonance, Melbourne, Australia. See CONF-690839.

The narrowing of the NMR spectra of solids by rapid specimen rotation is described with examples, and the theory of the effect of rotation on the various anisotropic nuclear interactions is summarized. The removal of dipolar and other sources of broadening enables fine structure to be revealed. Examples of chemical-shift fine structure in solids are phosphorus sesquisulfide, zinc phosphide, and phosphorus pentachloride. Examples of electron-coupled spin multiplets obtained in solids are potassium hexafluoroarsenate, hexafluoroantimonate, and hexafluorophosphate, which exhibit a quartet, sextet, and doublet, respectively. Work is also reported on sodium chloride, poly-tetrafluoroethylene, apatite, and copper. Consideration is given to the effect of macroscopic rotation on the spectrum of a solid that is already partially narrowed by molecular or ionic motion. Helium-driven gas turbines used for this work operate to 8 kHz and experimental turbines have achieved 12.5 kHz. Comparisons are made with other methods of coherent averaging, particularly the rotating field method and the multiple pulse methods. (auth)

51864 PROTON-DECOUPLED ^{13}C MAGNETIC RESONANCE. Grant, David M. (Univ. of Utah, Salt Lake City). pp 323-37 of Magnetic Resonance. /Coogan, C. K. (ed.). New York; Plenum Publishing Corp. (1970).

From International Symposium on Electron and Nuclear Magnetic Resonance, Melbourne, Australia. See CONF-690839.

Relative to proton NMR, low natural abundance (1.1%) of isotope carbon-13 and the reduced gyromagnetic ratio ($\gamma_{^{13}C}/\gamma_H = 0.251$) combine to reduce greatly the detectability of the ^{13}C NMR signal. Along with increasing sample size and utilizing time-averaging techniques, the signal-to-noise is significantly enhanced with proton decoupling techniques. This benefit arises from multiplet collapse and a nuclear Overhauser enhancement of about threefold for carbons with directly bonded hydrogens. The Overhauser mechanism presumes the dominance of the proton–carbon-13 dipole–dipole relaxation mechanism, which attenuates as $1/r_{CH}^6$. It is evident that other relaxation mechanisms compete and eventually dominate the dipolar one, thereby eliminating the nuclear Overhauser effect, wherever r_{CH} becomes large. Thus, carbons removed from hydrogens by two or more bonds exhibit a decreased resonance signal in proton-decoupled spectra, due to the competition from other relaxation mechanisms arising either from anisotropy in the chemical shift or from diffusional motion both of the translational and rotational variety. Two applications of this phenomenon are discussed. First, the resonance lines of bridgehead carbons in fused polycyclic aromatics are assigned on the basis of their distance from protons in the molecules. Second, the presence of very rapid methyl-group rotation in systems where the barrier restricting free motion of this type is very low appears to provide a competing process with the dipolar mechanism even for carbons with directly bonded hydrogens, and decreases in nuclear Overhauser factors are noted. These features are presented along with interesting multiple irradiation work now in progress. Relaxation-time data, which complement the Overhauser work, are obtained using the adiabatic rapid-passage two-pass method. (auth)

Theoretical Physics

51865 (AD–708490) STATUS OF CANONICAL QUANTIZATION. Bergmann, Peter G. (Syracuse Univ., N. Y. Dept. of Physics). Jun 1970. 25p. (AFOSR–70–1839–TR). NTIS.

Various approaches to canonical (local) quantization are related to each other, and their current status evaluated. Beginning with a review of Hamiltonian theory with first-class constraints, Schroedinger quantization, Hamilton–Jacobi theory with and without superspace, Feynman integrals, and the sandwich conjecture are next discussed; finally, some speculations of a general nature are given. (auth) (USGRDR)

51866 WHAT IS A QUASI-PARTICLE? Schrieffer, J. R. (Univ. of Pennsylvania, Philadelphia). J. Res. Nat. Bur. Stand.; 74A: 537-41(Jul-Aug 1970).

The concept of a quasi-particle excitation in an interacting many-body system is discussed from both the physical and the mathematical points of view. The physical origin of mass enhancement, wave function renormalization, interactions between quasi-particles, etc. is presented. Landau's Fermi liquid theory, including the quasi-particle kinetic equation, is reviewed. Finally, the domain of validity of the quasi-particle approximation is discussed. (auth)

51867 SIMULTANEOUS GENERATION OF TRANSITION RADIATION AND BREMSSTRAHLUNG FROM A THIN FOIL. I. Shieh, S. Y. (Univ. of Tennessee, Knoxville); Ritchie, R. H. Phys. Rev., B; 2: 1646-51(15 Sep 1970).

The usual procedure of reducing transition-radiation data by simply subtracting bremsstrahlung yield from the total yield ignores the coherent interference effect between transition radiation and bremsstrahlung. Assuming single scattering, the simultaneous generation of transition radiation and bremsstrahlung of a charged particle normally incident on a thin slab is analyzed here. The results obtained not only should be useful for reducing experimental data on transition radiation, but also should provide a new independent means to deduce the mean-square angle for single scattering. (auth)

51868 NEW GENERALISATIONS OF PAULI MATRICES. Ramakrishnan, Alladi (Inst. of Mathematical Sciences, Madras). pp 133-8 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

A summary is given of the major developments in quantum mechanics implying some particular aspect of the mathematical generalizations of the Pauli matrices. The Clifford algebraic generalization of the Pauli matrices, generalized Clifford algebra, the unitary matrices and generalized Gell–Mann–Nishjima relation, the Feynman propagator through the L-matrix formulation, and a new mass interpretation are covered. (J.F.P.)

51869 GENERAL RELATIVISTIC AND COVARIANT GENERALIZATION OF THE FIRST VORTICITY THEOREM OF HELMHOLTZ. Treder, Hans-Juergen (Deutsche Akademie der Wissenschaften zu Berlin, Babelsberg, Ger.). Beitr. Geophys.; 78: 436-42(1969). (In German).

The general relativistic and covariant differential form of the first vorticity theorem of Helmholtz is given. In connection with it, an invariant kinematical identity, which is the generalization of the Helmholtz theorem for general continua, is proved. (tr-auth)

51870 CALCULATION OF FLUXES OF LOW-ENERGY PROTONS BEHIND SHUTTERS IN PRESENCE OF ELECTRIC AND MAGNETIC FIELDS. Nachtmann, O. (Univ., Vienna). Acta Phys. Austr.; 30: 1-9(1969). (In German).

The intensity of a proton beam emerging from an extended source and passing two shutters is calculated. Formulas for the change of intensity due to weak electric and magnetic fields are derived. (auth)

51871 VECTOR STATES ON ALGEBRAS OF OBSERVABLES AND SUPERSELECTION RULES. II. ALGEBRAICAL THEORY OF SUPERSELECTION RULES. Sushko, V. N.; Khoruzhii, S. S. (All-Union Scientific-Research Inst. of Current Sources, Moscow. Inst. of Mathematics, Moscow). Teor. Mat. Fiz.; 4: 341-59 (Sep 1970). (In Russian).

Starting with the results of the general theory of vector states on algebras of observables obtained previously an exhaustive analysis of an arbitrary superselection rule (SR) is given. As a result, 3 fundamental physical conditions are formulated which are equivalent to each other and constitute the new purely algebraic definition of abstract SR. A number of new features of the SR are revealed, such as: all superselection operators have to be affiliated not only to the commutant, but to the center of the global observable algebra R; every physical theory possessing SR belongs to the class of "quantum theories with sufficient set of pure vector states," introduced previously. The possibility of continuous SR is discussed. The coherent superselection sector is defined as the type-I primary representation of the global observable algebra R. The properties of the theory restricted to the coherent sector are considered. (auth)

51872 NONRELATIVISTIC LIMIT OF THE DIRAC EQUATION IN THE CONTINUUM. Ronveaux, A. (Univ. Notre Dame de la Paix, Namur, France). Lett. Nuovo Cim.; 4: 703-6(10 Oct 1970).

It is shown that the statement that the radial Dirac equations reduce to the Schroedinger equation, with the assumptions that the kinetic energy of the particle is small and that the interaction potential is small with respect to the rest mass, is only formally true. In the investigated case it is found that the solutions of both equations can be extremely different. It is shown that there exist small potentials such that the behavior of the phase shift δ_L (k) near k = 0 is completely different in a Dirac or in a Schroedinger theory. The proof is based on the phase method applied to the Dirac equation. (J.F.P.)

51873 PARTIAL SEPARATION OF THE SCHROEDINGER EQUATION FOR TWO CHARGED PARTICLES IN A MAGNETIC FIELD. Carter, Benjamin P. (Univ. of California, Livermore). J. Math. Phys. (N. Y.); 10: 788-91(Apr 1969). (UCRL-71232).

An effective Hamiltonian is derived which describes the relative motion of two oppositely charged particles in a homogeneous magnetostatic field. (auth)

51874 BOUND-STATE PERTURBATION THEORY: A NEW APPROACH. Atkinson, D. (CERN, Geneva). Nucl. Phys.; B20: 125-58(1970).

New formulas are derived for the nth-order coefficients in the perturbation expansion of a bound-state energy in nonrelativistic quantum mechanics. These formulas involve only the unperturbed wave function and unperturbed energy, and not a sum over all the unperturbed states, as in the usual expressions. Explicit conditions for the convergence of the perturbation series are given, involving only the potentials, and the unperturbed wave functions. These conditions include bounds on truncation errors, so that one can compute in advance how many terms must be taken for a pre-assigned accuracy. (auth)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 52065 and 52391.

51875 (TID-25473(Vol.4)) EXPERIMENTS, 1969 Summer Study. Roberts, Arthur (ed.) (National Accelerator Lab., Batavia, Ill.). 324p. Dep. CFSTI.

Separate abstracts are prepared for each of the 33 papers included. (J.F.P.)

For abstracts of individual papers see: 51883–51888, 51909–51915, 51928–51936, 51953–51960, 52035, 52036, and 52177.

51876 HIGHLIGHTS OF HIGH ENERGY PHYSICS. Wilson, R. (Harvard Univ., Cambridge, Mass.). Nature (London): 227: 1018-19(5 Sep 1970).

A review is given of recent data provided by accelerators in various parts of the world, including "surprising" cross sections, electron–positron interactions, and in connection with the theory of quantum electrodynamics. (UK)

51877 STATUS OF THE EXPERIMENTAL SEARCH FOR PHYSICAL QUARKS. Jones, Lawrence W. (Univ. of Michigan, Ann Arbor). pp 225-36 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

The experimental situation behind the lack of concrete evidence for the existence of physical quarks is summarized with emphasis on the model-independent assumptions through which these experiments are interpreted as limits on quark mass and production mechanisms. It is believed that physical quarks are either unobservable or do not exist. (J.F.P.)

51878 QUARK SEARCH IN ORDINARY MATTER USING SIMULTANEOUS MEASUREMENT OF MASS AND CHARGE. Elbert, J. W.; Erwin, A. R.; Herb, R. G.; (and others) (Univ. of Wisconsin, Madison). Nucl. Phys.; B20: 217-35(1970).

A quark spectrometer was constructed which could measure both mass and charge simultaneously for individual particles. Exceptionally low counting backgrounds were obtained without sacrificing the ability to fully ionize the material being studied. The search was not restricted to fractionally charged particles but had reduced sensitivity for integer values of M/Q. The sensitivity was such as to allow definitive detection of one quark in 10^{13} to 10^{15} beam particles in the mass range from $\frac{1}{3}$ proton mass up to 60 proton masses. No evidence was found in the samples investigated for particles other than recognized ions, molecules, or radicals. (auth)

Electromagnetic

Refer also to abstracts 50590, 50592, 50606, 52177, 52396, and 52697.

51879 (DESY-70/32) PHOTOPRODUCTION OF VECTOR MESONS. Marshall, Robin (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science. Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Jul 1970. 31p. Dep. NTIS (U. S. Sales Only).

This review of the photoproduction of vector mesons emphasizes new and changed material. It covers the photoproduction of ρ on protons and on complex nuclei, the real part of the rho scattering amplitude, nuclei radii, the photoproduction of ω and ϕ, total hadronic cross sections, and other possible vector mesons. (J.F.P.)

51880 (LAL-1225) PHOTOPRODUCTION OF A POSITIVE PION FROM HYDROGEN AT 180^0 NEAR THE FIRST PION NUCLEON RESONANCE. Pahin, Jean-Pierre (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). Jan 1970. 112p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Univ. of Strasbourg, France.

The theory of the photoproduction of a positive pion from hydrogen was discussed. The different methods used for evaluating the dispersion integrals were then described. The detection of the backward scattered positive pion was made in the region of the first pion nucleon resonance. The experiments and the experimental apparatus were described in detail; the method used to calculate the dimensions of the diaphragms was given. The methods used to obtain, from the data, the differential cross sections in a center of mass system and the various corrections made were described; the results and their interpretation were discussed. (France)

51881 (LNF-70/32) A DISCUSSION ON SOME RECENT RESULTS ON COSMIC RAY MUONS. Note No. 484. Castagnoli, C.; Etim, E.; Picchi, P. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 10 Jul 1970. 15p. Dep. NTIS (U. S. Sales Only).

The discussion of recent results on cosmic muons and their interpretation covers muonproduction, horizontal air showers, and the zenith-angle distribution of high-energy muons. (J.F.P.)

51882 (SLAC-PUB-796) RECENT RESULTS IN INELASTIC ELECTRON SCATTERING. Bloom, E. D.; Buschhorn, G. (Stanford Linear Accelerator Center, Calif.); Breidenbach, M.; (and others) (Massachusetts Inst. of Tech., Cambridge). Sep 1970. Contract AT(30-1)-2098. 51p. (CONF-700806-40). Dep. CFSTI.

From 15th International Conference on High Energy Physics, Kiev, USSR.

A status report is presented on various inelastic e + p experiments. Some preliminary results are included on inelastic e + p and e + d interactions. (J.F.P.)

51883 (TID-25473(Vol.4), pp 77-8) ELASTIC ELECTRON AND MUON SCATTERING AT 100 GeV. Hofstadter, R. (Stanford Univ., Calif.).

It is pointed out that elastic electron scattering experiments at 100 GeV at $q^2 = 10$ $(GeV/c)^2$ and 20 $(GeV/c)^2$ are probably too difficult to perform at the National Accelerator Laboratory. On the other hand, at low q^2 values and at lower energies, a further study should be made. If the beam intensity can be improved above 10^7/sec, there should be a reinvestigation of the desirability of carrying out elastic scattering experiments at NAL. (auth)

51884 (TID-25473(Vol. 4), pp 123-38) SEARCH FOR HEAVY MUONS BY WIDE-ANGLE μ BREMSSTRAHLUNG AT NAL. Chen, K. W. (Princeton Univ., N. J.).

It is shown that a test of QED in the muon propagator can be performed at NAL with a sensitivity substantially higher than the g-2 experiment. Utilizing a highly collimated μ beam of high intensity ($\sim 10^8$/pulse) and low divergence (<2 mrad), heavy muon mass up to 8 GeV/c^2 can be searched for. In the more conventional description, an upper limit of about 1.0×10^{-15} cm or better on Λ^{-1} could be assigned. The contributions to wide-angle bremsstrahlung from nuclear Compton scattering and inelastic bremsstrahlung need to be carefully investigated but are expected to contribute insignificantly if sufficient care is taken to choose the proper kinematical configuration of the outgoing muon and the gamma ray. (auth)

51885 (TID-25473(Vol.4), pp 139-47) FIRST-GENERATION ELECTROMAGNETIC EXPERIMENTS AT NAL. Brenner, A. E. (Harvard Univ. [Cambridge, Mass.]).

Several possible first-generation electron and photon experiments are listed and two are studied in some detail. These are Compton scattering and photo-production of vector mesons. (auth)

51886 (TID-25473(Vol.4), pp 149-60) MEASURING TOTAL CROSS SECTIONS FOR 100-GeV PHOTONS. Diebold, R. (Argonne National Lab., Ill.); Hand, L. (Cornell Univ., Ithaca, N. Y.).

The total hadronic cross sections for γ rays on various elements, hydrogen through lead, can be measured in a straightforward way at NAL up to photon energies of about 120 GeV. Special counters will be used to detect both the loss of a tagged photon and the appearance of at least one of its reaction products. This is a relatively easy experiment of fundamental theoretical interest and should be considered as one of the first experiments at NAL. (auth)

51887 (TID-25473(Vol. 4), pp 161-9) ELASTIC COMPTON SCATTERING ($\gamma + p \rightarrow \gamma + p$) AT NAL. Budnitz, R. J. (California Univ. [Livermore]. Lawrence Radiation Lab.).

The problems associated with a 40 to 75 GeV measurement of elastic Compton scattering ($\gamma + p \rightarrow \gamma + p$) are examined, and a specific experimental apparatus is proposed. This is an elaboration of an earlier note on the same topic. Numerical estimates are given for the important uncertainties, and methods are suggested for treating some background processes. The Compton experiment is certainly feasible and should be one of the early measurements made in the proposed NAL tagged-photon facility. (auth)

51888 (TID-25473(Vol.4), pp 171-82) DEEP INELASTIC COMPTON SCATTERING AT NAL. Budnitz, R. J. (California Univ. [Livermore]. Lawrence Radiation Lab.); Heusch, C. A. (California Inst. of Tech., Pasadena).

An experimental design is discussed for performing the deeply inelastic Compton scattering experiment at incident photon energies up to 40 GeV at NAL. The counting rate is calculated using one specific model for the process, that of Bjorken and Paschos. Background processes are expected to come in at a manageable level, but present experimental evidence needed for their evaluation is in a state of uncertainty. (auth)

51889 π^+ PHOTOPRODUCTION FROM HYDROGEN WITH POLARIZED PHOTONS. Bar-Yam, Z.; (Southeastern Massachusetts Univ., North Dartmouth); Pagter, J.; Dowd, J.; Kern, W.; Luckey, D.; Osborne, L. S. Contracts AT(30-1)-4115; AT(30-1)-2098. Phys. Rev. Lett.: 25: 1053-6(12 Oct 1970).

The reaction $\gamma_\perp, \|p \to \pi^+ n$ was studied with linearly polarized photons of energy 3.0 GeV at $-t$ values between 0.15 and 1.2 $(GeV/c)^2$. The asymmetry $A^+ = (d\sigma_\perp - d\sigma_\|)/(d\sigma_\perp + d\sigma_\|)$ is found to be positive throughout this four-momentum-transfer range, implying the dominance of natural parity exchange in the t channel. Comparison of $d\sigma_\perp(\gamma_\perp p \to \pi^+ n)$ and $d\sigma_\perp p \to \pi^- p)$ from a previous experiment indicates strong interference between the isoscalar and isovector photon amplitudes for photons polarized perpendicular to the production plane. (auth)

51890 TOTAL CROSS SECTION FOR PHOTOPRODUCTION OF HADRONS ON HYDROGEN AND DEUTERIUM BETWEEN 1.0 AND 6.4 GeV. Meyer, H. (Deutsches Elektronen-Synchrotron, Hamburg); Naroska, B.; Weber, J. H.; Wong, M.; Heynen, V.; Mandelkow, E.; Notz, D. Phys. Lett.; 33B: 189-92(28 Sep 1970).

The total cross section for hadron production by photons on hydrogen $\sigma(\gamma p)$ and deuterium $\sigma(\gamma d)$ was measured for beam energies from 1.0 to 6.4 GeV. The cross section on neutrons is determined from the D_2 and H_2 data using a Glauber correction. (auth)

51891 CONSERVATION OF PARITY IN ELECTROMAGNETIC INTERACTIONS. Koopmann, E. W.; Van Krugten, H.; Van Nooijen, B.; Wapstra, A. H. (Technische Hogeschool, Delft, Netherlands). Nucl. Phys.; B19: 107-12(1970).

The suggestion of Mendels and Wouthuysen that nonnuclear electrons might show an a priori polarization in their interactions was investigated by the measurement of the circular polarization of high-energy bremsstrahlung quanta produced by such electrons. These experiments show no evidence for violation of parity conservation in electromagnetic interactions. (auth)

51892 IONIZATION LOSS BY HIGH-ENERGY ELECTRONS IN NUCLEAR EMULSION. Tirler, R. (Max-Planck-Institut fuer Physik and Astrophysik, Munich). Nuovo Cim.; 69A: 686-90(21 Oct 1970).

The ionization loss of electrons in the energy range $\gamma = 120$ to 6300 was investigated using Ilford G.5 emulsions. The results show very good agreement with Sternheimer's ionization loss theory. No apparent evidence for a decrease in ionization loss through radiative corrections according to the theory of Tsytovich is observed. (auth)

51893 PHOTOPRODUCTION OF NEUTRAL RHO MESONS. Alvensleben, H.; Becker, U.; Bertram, William K.; (and others) (DESY, Hamburg. Massachusetts Inst. of Tech., Cambridge). Nucl. Phys.; B18: 333-65(1970).

Results of measurements on photoproduction of ρ^0 mesons are presented. Analysis of 10^5 measured π-pairs on protons in the energy region 2.6 to 6.8 GeV, using various assumptions of rho production, indicates that $d\sigma/dt(t = 0)$ decreases with increasing energy similar to πN scattering. Analysis of 10^6 measured π-pairs from 13 complex nuclei in a four-dimensional data matrix $d\sigma/d\Omega dm(A.m.p.t_\perp)$ with dimensions 13, 20, 6, and 20 yields precise information on nuclear density distributions determined by ρ-production. For the Woods–Saxon radii $R(A) = (1.12 \pm 0.02)$ $A^{\frac{1}{3}}$ fm is obtained and using the vector-dominance model, $\sigma_{\rho N} = 26.7 \pm 2.0$ mb and $\gamma_\rho^2/4\pi = 0.57 \pm 0.10$. (auth)

51894 RHO MESON PHOTOPRODUCTION FROM COMPLEX NUCLEI. Leith, D. W. G. S. (Stanford Linear Accelerator Center, Calif.). pp 395-425 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A review is given of ρ^0 photoproduction on complex nuclei. Also photon absorption in complex nuclei is reviewed. It is shown that there are some disagreements with the vector dominance model. A model which extends rho dominance to a generalized vector meson dominance is introduced, which could take these disagreements into account. It is found that for masses up to 1800 MeV there is no evidence of other vector mesons which strongly couple to 2π. Therefore the additional contribution comes from even higher mass states. (J.F.P.)

51895 PHOTOPRODUCTION OF RHO MESONS FROM COMPLEX NUCLEI. Knasel, T. M. (Massachusetts Inst. of Tech., Cambridge). pp 426-9 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A study of one million $\pi\pi$ events in the ρ mass region from 14 elements from hydrogen to uranium was made. Measurements were made over a wide range of the kinematical quantities, and thus the cross sections can be presented free of theoretical assumptions. The radius of the nuclear target and rate of reabsorption of the ρ in the nucleus, Woods-Saxon radii of these elements, and the ρ-N total cross section and the coupling constant are found. (J.F.P.)

51896 CURRENT DEVELOPMENTS IN THE STUDY OF ELECTROMAGNETIC PROPERTIES OF MUONS. Picasso, E. (CERN, Geneva). pp 615-35 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The electromagnetic properties of the muon at low and high momentum transfers are reviewed. This review covers the muon anomalous magnetic moment, the muonium atom, the 2s-2p energy difference of muonic hydrogen, and the electric dipole moment. Also the elastic muon-nucleon scattering, muon pair production, muon tridents, and the relative electron, muon form factors for time-like photons are discussed. (J.F.P.)

51897 POSITIVE MUON MAGNETIC MOMENT. Hutchinson, D. (Princeton-Pennsylvania Accelerator, Princeton, N. J.); Kanofsky, A.; Larsen, F.; Schoen, N.; Sober, D. pp 636-9 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The magnetic moment of the positive muon was measured by determining its precession frequency in a magnetic field. The experimental arrangement and the various errors and corrections are described. The value found is $\omega_\mu/\omega_p = 3.18335 \pm 0.00005$. (J.F.P.)

51898 PHOTOPRODUCTION OF MUON PAIRS. Hayes, S.; Imlay, R.; Joseph, P. M.; Keizer, A. S.; Knowles, J.; Stein, P. C. (Cornell Univ., Ithaca, N. Y.). pp 656-60 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Preliminary results are given for experiments the objects of which were to measure the branching ratio of $\phi \to \mu^+ + \mu^-$, to search for production of new vector mesons, and to look for deviations from the predictions of QED at higher masses. Photon reactions with carbon were used for this study. The preliminary results are given. (J.F.P.)

51899 ρ^0-AND φ^0-MESON PHOTOPRODUCTION FROM HYDROGEN AND DEUTERIUM. Kawaguchi, Masaaki; Sakai, Hisakazu; Sumi, Yoshio (Osaka Univ.). Progr. Theor. Phys. (Kyoto); 44: 172-82(Jul 1970).

The ρ^0- and φ^0-meson photoproduction from hydrogen and deuterium is studied. In the relation between cross sections on hydrogen and deuterium target it is found that the deuteron form factor plays an important role. Effects of isoscalar part of photon and the Glauber correction are also discussed. (auth)

51900 SINGLE PHOTOPRODUCTION OF NEUTRAL π-MESONS ON HYDROGEN IN THE EXTREME FORWARD DIRECTION AT 4 AND 5.8 GeV. Braunschweig, M.; Braunschweig, W.; Husmann, D.; Luebelsmeyer, K.; Schmitz, D. (Univ., Bonn. Kernforschungsanlage, Juelich, Ger.). Nucl. Phys.; B20: 191-200(1970).

The differential cross section of the reaction $\gamma p \to p\pi^0$ was measured at the Deutsches Elektronen Synchroton (DESY) Hamburg, at mean photon energies of 4.0 and 5.8 GeV for pion c.m. angles between 0° and 5° in steps of 1°. The production near 0° is dominated by the Primakoff effect. (auth)

51901 SPIN–PARITY ANALYSIS OF THE $K^*(890)\pi$ SYSTEM IN THE Q-REGION. Antich, P.; Carson, R.; Chien, C. Y.; (and

others) (Johns Hopkins Univ., Baltimore). Nucl. Phys.; B20: 201-8(1970).

A multipole moments analysis was used to determine the spin–parity of the $K^*\pi$ system in the Q-region (1.0 GeV < M($K^*\pi$) < 1.48 GeV), using events from the reaction $K^+p \rightarrow K^+p\pi^+\pi^-$ at 5.5 GeV/c. It is found that $J^P = 1^+$ over the whole of this mass range. Observed effects which could be due to the presence of states of higher spin in the Q-enhancement (or to the presence of Kρ decay mode of the Q) can be satisfactorily explained as arising from the cuts made in the data for the $K^*\pi$ decay of a pure $J^P = 1^+$ state. (auth)

51902 SCALING, DUALITY, AND THE BEHAVIOR OF RESONANCES IN INELASTIC ELECTRON–PROTON SCATTERING. Bloom, E. D.; Gilman, F. J. (Stanford Univ., Calif.). Phys. Rev. Lett.; 25: 1140-3(19 Oct 1970).

It is proposed that a substantial part of the observed behavior of inelastic electron–proton scattering is due to nondiffractive component of virtual photon–proton scattering. The behavior of resonance electroproduction is shown to be related in a striking way to that of deep inelastic electron–proton scattering. Relations are derived between the elastic and inelastic form factors and the threshold behavior of the inelastic structure functions in the scaling limit. (auth)

Weak

Refer also to abstracts 50593–50596, 52047, 52263, 52264, and 52327.

51903 (AEC-tr-7156) SEARCH FOR THREE-VECTOR CORRELATIONS IN DECAY OF POLARIZED NEUTRONS. Erozolimskii, B. G.; Bondarenko, L. N.; Mostovoi, Yu. A.; Obinyakov, B. A.; Zakharova, V. P.; Titov, V. A. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). Translation of report IAE-1891. 18p. Dep. CFSTI.

The value of the constant D was determined for triple correlation between the vectors of neutron spin $\vec{\sigma}$ and electron momenta $\vec{P}_e$ and antineutrino momenta $\vec{P}_\nu$: -0.01 ± 0.01; this corresponds to the phase difference between the axial-vector and vector constants of the weak interaction $\varphi = 181.3^0 \pm 1.3^0$. (auth)

51904 (SLAC-124) NEUTRAL PION AND ETA PHOTOPRODUCTION FROM HYDROGEN AT HIGH ENERGIES. Johnson, James R. (Stanford Linear Accelerator Center, Calif.). Sep 1970. Contract AT(04-3)-515. 95p. Dep. NTIS.

Measurements were made of the process $\gamma p \rightarrow \pi^0 p$ for photon energies from 4 to 18 GeV and four-momentum transfers t between -0.1 and -1.4 $(GeV/c)^2$. The reaction $\gamma p \rightarrow \eta p$ was studied between 4 and 9 GeV for t-values from -0.3 to -1.4 $(GeV/c)^2$. The experiment was carried out at the Stanford Linear Accelerator Center (SLAC) by passing the SLAC photon beam through a target containing gaseous hydrogen for small momentum transfers and liquid hydrogen for higher t-values. The recoil protons were analyzed and detected in the SLAC 1.6-GeV/c spectrometer, and the "missing mass" of the neutral product was calculated from kinematics. The π^0 photoproduction cross sections decrease rapidly with increasing $|t|$ beyond $|t| = 0.1$, show a local minimum or "dip" around $|t| = 0.5$ and a secondary maximum for $|t| \approx 0.85$, then fall off smoothly out to $|t| = 1.4$. The energy dependence appears close to E_γ^{-2}, becoming only gradually steeper with increasing $|t|$, contrary to some theoretical predictions. The energy dependence of η production is consistent with E_γ^{-2}, but the t-dependence shows only a smooth decrease with $|t|$ and no sign of a dip at $t = -0.5$ $(GeV/c)^2$. A simple t-channel exchange model cannot then explain both processes with the same assumptions, even though the quantum numbers of the two mesons are the same except for isospin. (auth)

51905 (TID-25473(Vol. 1), pp 343-52) ELECTRON-NEUTRINOS, ν_e. Kalbfleisch, G. R. (Brookhaven National Lab., Upton, N. Y.).

Electron (rather than muon) neutrino interactions are properly the ones to use in comparing results with e-p interactions. Electron-neutrino fluxes from muons as well as kaons are crudely estimated. The muonic electron-neutrinos are more numerous than the kaonic ones but peak at a lower energy of course. Typical runs in the 25-foot (H or D) bubble chamber should yield several thousand ν_e interactions over the range 3 to 50 GeV in the current Nezrick beam. Identification of these events (electron track) should be easier than the corresponding muonic ones with a suitable plate array or track-sensitive target (Ne-H_2 or Ne-D_2) in the chamber. Some possibilities for greater ν_e yields in the future are indicated which will allow detailed studies of exotic processes (such as $\nu_e + e \rightarrow \nu_e + e$) also. (auth)

51906 (TID-25473(Vol. 2), pp 121-42) HIGH ENERGY NEUTRINO PHYSICS ($E_\nu > 20$ GeV) AND THE CONSTRAINTS PLACED ON THE DETECTORS. Stevenson, M. L. (California Univ., Livermore. Lawrence Radiation Lab.).

Two classes of high-energy neutrino experiments were considered: W production and the measurement of total cross section as a function of energy and momentum transfer. The first experiment requires that converting material be placed primarily downstream to detect any π^0 or neutron decay fragments of the W which carry off most of the incident neutrino's momentum. The second experiment requires both downstream converter and transverse converter. As a possible detector the BNL 25-foot bubble chamber was considered with a track-sensitive target cylinder of H_2 or D_2 placed in a 30% neon-H_2 mixture. The effective volume of H_2 and D_2 for the various experiments is summarized in graphical form. Generally the effective volume is less than 10 m^3 when one or more π^0's are involved in the experiment. When a neutron is involved, the effective volume is less than 8 m^3. If the 25-foot chamber is changed from football shape to a basketball shape (23-foot diameter), a factor of $\approx$4 is gained in the effective volume. Generally, for neutrino physics, it is more important to measure curvature than angles. Therefore, the magnetic field should be kept as high as possible. (auth)

51907 (TID-25473(Vol.2), pp 143-57) LEPTON PAIR PRODUCTION BY NEUTRINOS. Baltay, C. (Columbia Univ., New York); Wachsmuth, H. (Wisconsin Univ., Madison. European Organization for Nuclear Research, Geneva (Switzerland)).

The study of the lepton pair production processes $\nu_\mu + Z \rightarrow Z + \mu^- + \mu^+ + \nu_\mu$ and $\nu_\mu + Z \rightarrow Z + \mu^- + e^+ + \nu_e$ in liquid neon in a 25-ft bubble chamber is considered. It is concluded that this experiment is very difficult but feasible. This experiment is also sensitive to the production of the intermediate boson if the mass of the boson is less than about 9 BeV. (auth)

51908 (TID-25473(Vol.2), pp 159-63) HYPERON PRODUCTION BY ANTINEUTRINOS AND SELECTION RULE TESTS. Wachsmuth, H. W. (Wisconsin Univ., Madison. European Organization for Nuclear Research, Geneva (Switzerland)).

Rates are estimated for hyperon production in antineutrino experiments in the 25-ft bubble chamber (hydrogen target surrounded by neon). Possible tests of the weak-interaction selection rules in antineutrino interactions are enumerated. (auth)

51909 (TID-25473(Vol.4), pp 79-83) MUON INTERACTIONS AT NAL. Pipkin, F. M. (Harvard Univ. [Cambridge, Mass.]).

The recommendations of the committee on muon interactions are summarized. The possible location of the beam is briefly discussed. (auth)

51910 (TID-25473(Vol.4), pp 85-99) LARGE MOMENTUM TRANSFER INELASTIC MUON SCATTERING AT NAL. Hand, L. N. (Cornell Univ., Ithaca, N. Y.).

Experiments to measure the deep inelastic scattering of 100-GeV muons are considered. Both single-arm (Stage I) and coincidence (Stage II) experiments look feasible, using a toroidal iron spectrometer and detecting scattered muons between 60 mrad and 150 mrad. Background from pion decays is minimized by maximizing the muon transverse momentum. For muon beams of 10^7/sec rates of 70/hr (Stage I) and 8/hr (Stage II) are expected without serious problems at momentum transfers between 20 and 80 $(GeV/c)^2$. The Stage I experiment is of great interest and appears practical for an early stage of machine operation since it is both simple and relatively inexpensive. (auth)

51911 (TID-25473(Vol.4), pp 111-21) SEARCH FOR HEAVY LEPTONS. Heusch, C. A. (California Inst. of Tech., Pasadena); Sandweiss, J. (Yale Univ., New Haven, Conn.).

Experimental possibilities are described to check on the hypothesis that there are leptons with masses higher than that of the K meson. After a brief review of production and decay mechanisms for such heavy leptons, their predicted characteristics are used to evaluate various schemes for their detection. While clashing-beam facilities and high-intensity electron linacs appear most useful for some of these schemes, a particularly attractive experimental method may be exploited in the tagged photon facility to be built at the 200-GeV National Accelerator Laboratory. (auth)

51912 (TID-25473(Vol.4), pp 183-4) ZERO-ORDER PROPOSAL FOR THE SEARCH FOR W MESON. Jovanovic, D. D. (Argonne National Lab., Ill.).

A method for searching for the neutrino-produced W in spark chambers based on observing the lepton pair originating from the same vertex is proposed. (J.F.P.)

51913 (TID-25473(Vol.4), pp 191-9) SEARCH FOR THE W BOSON WITH HIGH-ENERGY MUONS. Kirk, T. (Harvard Univ. [Cambridge, Mass.]).

A search for the W boson using 100-GeV muons is proposed. It is shown that W masses up to about 10 GeV can be seen provided the branching ratio to muon plus neutrino is no worse than 0.1. Background comes in at about 10^{-39} cm^2 and expected rates are one per hour. (auth)

51914 (TID-25473(Vol.4), pp 201-7) W SEARCHES WITH HIGH-ENERGY NEUTRINOS AND HIGH-Z DETECTORS. Mann, A. K. (Pennsylvania Univ., Philadelphia).

The feasibility of W searches with high-energy neutrinos incident on high-Z material and spark-chamber detection of the final-state particles is assessed. It appears from consideration of W production and detection rates, event recognition and possible backgrounds that a realistic W search in an interesting region of W mass can be made at NAL with that experimental technique. (auth)

51915 (TID-25473(Vol.4), pp 209-18) SEARCH FOR INTERMEDIATE VECTOR BOSONS AND OTHER PROCESSES USING HIGH-ENERGY NEUTRINOS AND Fe-MAGNET SPARK CHAMBERS. Mayer, Stuart L. (Northwestern Univ., Evanston, Ill.).

Previous discussions of spark-chamber W searches are extended to the entire range of interesting W masses. The detector system previously described is emphasized, and the standard of comparison was the neutrino facility. The conclusion is that the (200 GeV) W search is quite feasible for masses up to 8 GeV/c^2 but that significant improvement in the beam is both possible and highly desirable for this experiment. (auth)

51916 $K_L - K_S$ REGENERATION AT HIGH ENERGIES. Foeth, H. (Technische Hochschule, Aachen); Darriulat, P.; Ferrero, M. I.; (and others). pp 440-2 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The K_L^0 intensity was measured observing the decays into the $\pi^+\pi^-$ mode after lead regenerators of various thicknesses were exposed to a K^0 beam. Also the q^2 dependence of the differential nuclear regeneration cross section was measured up to momentum transfers of 0.16 GeV/c, far beyond the first diffraction minimum. The parameters of the neutron distribution are given, and experimental results are compared to optical model predictions. (J.F.P.)

51917 SEARCH FOR THE $\pi^+ \rightarrow e^+ + e^+ + e^- + \nu$ DECAY. Korenchenko, S. M.; Kostin, B. F.; Morozov, A. G.; Micelmacher, G. V.; Nekrasov, K. G. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 680-1 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A cylindrical spark chamber was used to study the decay $\pi^+ \rightarrow e^+ + e^+ + e^- + \nu$. This decay was not found, but an upper limit is given for the branching ratio. (J.F.P.)

51918 ENERGY SPECTRUM OF THE π^+ IN $K^+ \rightarrow \pi^+\pi^0\pi^0$ DECAY. Davison, Donald Craig. Riverside, Calif.; Univ. of California (1969). 47p.

Thesis.

The low-energy portion of the τ' spectrum was measured in emulsion and the high-energy portion was measured in a heavy liquid bubble chamber. The final data consist of 642 events in emulsion and 3406 events in the bubble chamber. Fits were made to several models including the linear spectrum and the Brown-Singer σ-resonance. The data somewhat favor the σ-resonance model. In the linear spectrum approximation the ratio of the τ' slope to a recent measurement of the τ slope disagrees with a prediction of $\Delta I = 1/2$ rule by 5 standard deviations, indicating a violation of the $\Delta I = 1/2$ rule for three pion decay of the kaon. The difference between the $\Delta I = 1/2$ rule prediction and experiment can be interpreted as a $\Delta I = 3/2$ contribution. (Diss. Abstr. Int., B)

51919 FINAL-STATE INTERACTIONS IN DECAY OF LIGHT HYPERNUCLEI. Rao, N. K. (Tata Inst. of Fundamental Research, Bombay); Swami, M. S.; Gurtu, A.; Singh, M. B. Proc. Indian Acad. Sci., Sect. A; 71: 257-65(Jun 1970).

The excited states of ^{4}Li, ^{5}Li, and ^{8}Be have been investigated by studying the final state interactions in the π^--mesic decays of $_\Lambda$He^4, $_\Lambda$He^5 and Li^8 respectively. The experimental results indicate the existence of final states like Li^{5*} at 1.8 MeV and Be^{8*} at 0 and 2.9 MeV to be dominant in the decay of $_\Lambda$He^5 and $_\Lambda$Li^8 respectively; the results on the decay of $_\Lambda$He^4 suggest the presence of a Li^{4*} state at about 4 MeV to dominate. (auth)

Strong (Baryon-Induced)

Refer also to abstracts 50613, 51987, 52111, and 52135.

51920 (CERN-70-23) GRAPHICAL MAN-MACHINE INTERACTIVE SYSTEMS FOR NUMERICAL PROBLEMS: PEG, A SPECIAL PURPOSE SYSTEM; AND GAMMA, A GENERAL PURPOSE SYSTEM. Smith, L. B.; Vandoni, C. E. (European Organization for Nuclear Research, Geneva (Switzerland)). 18 Aug 1970. 48p. Dep. CFSTI (U. S. Sales Only).

With on-line (time-sharing) computer systems and graphic terminals we have available a new dimension in numerical problem solving capabilities. Rather than simply use the new power to achieve fast turn around we can develop interactive routines which are easy to use and also take advantage of the insight and visual capabilities of the human problem solver. Several on-line systems for general purpose mathematical problem solving have already been implemented as well as some special purpose systems for solving problems in a particular area, such as ordinary differential equations. The advantage of restricting the problem area is that the interface with a user can be greatly simplified. This paper discusses some of the advantages accrued by such systems and design considerations for interactive routines. Furthermore, as examples of such systems, PEG (developed at Stanford University, Stanford, California by the first author), an implementation of a special purpose system for on-line least squares data-fitting, is presented with results obtained on empirical data and GAMMA (developed at CERN by the second author), a general purpose system for on-line mathematics, is also described in some detail. (auth)

51921 (NP-18445) CONTRIBUTION TO THE STUDY OF THE anti pp IN FLIGHT ANNIHILATION MECHANISM AT 3.6 GeV/c BY THE ANALYSIS OF THE ANGULAR DISTRIBUTIONS OF THE SECONDARY PARTICLES PRODUCED. de La Vaissiere, Christain (Paris Univ. (France). Faculte des Sciences). 1970. 124p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis.

The methods employed in automatic measurement and the HPD system chosen are described. Suggestions of improvements to the system for future studies were made. The general characteristics of the $\bar{p}p$ annihilation into 4 and 6 charged pions at 3.6 GeV/c were studied. The angular distribution of the pions was very dependent upon the mode of annihilation, and the primary pions must be distinguished from the secondaries originating from the disintegration of the resonances. A charge asymmetry of the π^+ and the π^- was noticed indicating the presence of peripheral exchange processes: $p \rightarrow n + \pi^+$ or $\bar{p} \rightarrow \bar{n} + \pi^-$. The exact angular distributions of the mesons ρ^0, ω and f produced were studied. The ρ^+ and ρ^- presented asymmetries comparable to those of the π^+ and π^-. The collimation of the neutral resonances was general. Resonances were introduced into the multiperipheral model. The principal characteristics of the angular distributions were thus reproduced, in particular the simultaneous statistic and peripheral properties of the annihilations, in spite of the simplifying hypotheses made. (France)

51922 (NP-18466) RESEARCH INTO HEAVY RESONANCES IN THE REACTION $\bar{p}p \rightarrow 3\pi^+3\pi^-\pi^0$ AT 3.6 GeV/c. Yiou, Tchiu-Pung (Paris Univ., Orsay (France). Faculte des Sciences). 1970. 103p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Heavy resonances in the $\bar{p}p \rightarrow 3\pi^+3\pi^-$ and the $\bar{p}p \rightarrow 3\pi^+3\pi^-\pi^0$ reactions at 3.6 GeV/c were investigated. Serious difficulties were encountered in the analysis of the experimental results because of the background noise produced by large numbers of particles observed in the final state. In spite of this, from the extensive data obtained, numerous heavy mesonic resonances were found and precise information about their modes of disintegration obtained. The signals observed were weak, but they all corresponded to the masses associated with recently discovered resonances. The predictions of the Regge pole model and certain quark models were confirmed. (France)

51923 (TID-25473(Vol.1), pp 397-401) EMPIRICAL ESTIMATE OF SECONDARY FLUXES PRODUCED BY 200-GeV PROTONS. Cocconi, G. (European Organization for Nuclear Research, Geneva (Switzerland)).

The fluxes of the long-lived particles that will be produced by the NAL 200-BeV proton accelerator with a hydrogen target are evaluated by extrapolating the data made available at present by the NAL, CERN, and Serpukhov machines. (auth)

51924 (TID-25473(Vol.1), pp 403-16) EMPIRICAL PION AND KAON FLUXES FROM 200 GeV PROTON INTERACTIONS. Nezrick, F. A. (National Accelerator Lab., Batavia, Ill.).

New estimates of the charged pion and kaon fluxes at 200 GeV have been made using an empirical model. The model assumes 1) the forward pion spectra predicted by the Hagedorn-Ranft model, 2) a K/π ratio empirically determined from experiments, and 3) a transverse momentum distribution given by $e^{-p\theta/b}$. The

resulting spectra, mean transfer momenta, and multiplicities are compared with the Hagedorn–Ranft and CKP models. (auth)

51925 (TID–25473(Vol.1), pp 417-20) NEUTRINO AND ANTI-NEUTRINO FLUX USING THE EMPIRICAL PION AND KAON SPECTRA. Kang, Y. W.; Nezrick, F. A. (National Accelerator Lab., Batavia, Ill.).

The neutrino and anti-neutrino fluxes produced from 200-GeV proton interactions have been calculated assuming the FANC pion and kaon spectra. The fluxes are calculated for a real focusing system and a muon shield 150 m thick. A comparison is made between the neutrino spectra obtained from the FANC and CKP secondary production spectra. (auth)

51926 (TID–25473(Vol.2), pp 113-20) NEUTRINO LEPTON SCATTERING. Nezrick, F. A. (National Accelerator Lab., Batavia, Ill.).

The four-fermion interactions which can be produced by muon and electron neutrino beams at 200 GeV are studied. The reaction cross sections, neutrino fluxes, and event rates are presented. The only reaction which it appears reasonable to study in a five-ton liquid hydrogen detector is $\nu_\mu + e^- \rightarrow \nu_e + \mu^-$. The backgrounds encountered in studying this reaction are discussed. (auth)

51927 (TID–25473(Vol.3), pp 141-4) PROTON–PROTON POLARIZATION EXPERIMENTS AT NAL: POLARIZED TARGETS VS POLARIZATION ANALYZERS. Neal, H. A. (Indiana Univ., Bloomington).

Two possible schemes to measure the polarization in elastic proton–proton scattering at 200 GeV/c have been considered. One involves a polarized target and the other a double scattering technique. It is concluded that, due to the limitation of the maximum allowable proton flux on the polarized target, the two techniques are indeed competitive for large $|t|$ measurements. (auth)

51928 (TID–25473(Vol.4), pp 1-17) INTERACTIONS WITH TWO-BODY AND QUASI TWO-BODY FINAL STATES. Diebold, R. E. (Argonne National Lab., Ill.); Fowler, E. (Duke Univ., Durham, N. C.); Heinz, R. M. (Indiana Univ., Bloomington); Pipkin, F. (Harvard Univ. [Cambridge, Mass.]); Prentice, J. (Toronto Univ. (Ontario)).

To aid in the design of spectrometer systems at NAL, high-energy reactions with two particles or resonances in the final state are tabulated. (auth)

51929 (TID–25473(Vol.4), pp 59-65) ELASTIC AND INELASTIC SCATTERING EXPERIMENTS WITH A SINGLE-ARM WIRE-PLANE SPECTROMETER. Terwilliger, K. M. (Michigan Univ., Ann Arbor).

This report describes experiments using a single-arm wire-plane spectrometer system to study elastic scattering and inelastic isobar production at 100 GeV/c, with either a secondary beam or the full intensity extracted proton beam. (auth)

51930 (TID–25473(Vol.4), pp 187-9) BEAM DUMP EXPERIMENT: UTILIZATION OF MUON POLARIZATION EFFECT IN W SEARCH. Chen, K. W. (Princeton Univ., N. J.).

A W-meson search is considered in a beam-dump experiment similar to that performed at AGS by the Yale-BNL group. The intensity and longitudinal polarization of the μ_W is investigated at the production. The sensitivity and limitation of the search at NAL are presented. (auth)

51931 (TID–25473(Vol.4), pp 219-26) SEARCH FOR MASSIVE MUON PAIRS. Christenson, J. H. (Columbia Univ., New York); Sculli, J. (National Accelerator Lab., Batavia, Ill.).

A proton beam dump experiment to scan the mass spectrum of muon pairs in the mass range $5 < m_{2\mu} < 20$ GeV/c^2 is proposed. Both muons are momentum-analyzed in a solid-iron magnet spectrometer. The mass resolution varies from 14% at 5 GeV/c^2 to 8% at 20 GeV/c^2, being largely determined by multiple scattering in the hadron shield. In a few hundred hours, one should be able to measure cross sections as small as 10^{-41} cm^2. (auth)

51932 (TID–25473(Vol.4), pp 291-7) MISSING-MASS TECHNIQUE FOR DIFFRACTION DISSOCIATION STUDIES. Foelsche, Horst W. (Brookhaven National Lab., Upton, N. Y.); Reeder, Donald D. (Wisconsin Univ., Madison).

The fundamental limitations of the missing-mass technique for surveys of coherently produced resonances were examined. It was concluded that such experiments are natural thin-target experiments which will require high-intensity secondary beams — typically 10^8 particles per pulse. Although the rates are low, they are found encouraging, and it is concluded that it would be a mistake to give up on this technique. (auth)

51933 (TID–25473(Vol.4), pp 303-6) COMMENTS ON THE IMPORTANCE AND FEASIBILITY OF EXPERIMENTS ON THE REACTION $\bar{p} + p \rightarrow \pi^+ + \pi^-$, ETC., UP TO 50 GeV/c. Murphy, C. T. (Carnegie-Mellon Univ., Pittsburgh, Pa.).

It is important to study the reaction $\bar{p}p \rightarrow \pi^+\pi^-$ and other annihilation reactions producing dimeson final states, in the momentum region 10–50 GeV/c, since such reactions are related to $\pi^\pm p$ backward scattering by crossing symmetry. Estimates of rates are presented. Comments, but no detailed designs, are given on methods to do these experiments. (auth)

51934 (TID–25473(Vol.4), pp 307-12) Λ–P TOTAL CROSS SECTION AND SMALL-ANGLE ELASTIC CROSS-SECTION MEASUREMENTS. March, R. H. (Wisconsin Univ., Madison).

A neutral hyperon beam suitable for measuring the Λ–p total cross section in the energy range 80 to 170 GeV/c is described. It may also be suitable for measuring the elastic cross section in the range $0.05 < t < 1.3$ GeV^2 over the same energy range. The former experiment can be performed at beam survey intensities (10^7 to 10^8 protons on target), while the latter requires the full 10^{10} intensity of a high-flux secondary proton beam. Equipment requirements are modest for both experiments. (auth)

51935 (TID–25473(Vol.4), pp 313-18) SEARCH FOR THE $\Delta S = 2$ DECAY $\Xi^0 \rightarrow p\pi^-$. March, R. H. (Wisconsin Univ., Madison).

An experiment is proposed to search for the $\Delta S = 2$ decay $\Xi^0 \rightarrow p\pi^-$, using a neutral hyperon beam. With 10^{10} protons per pulse on target, if the Ξ^0/Λ production rate is as high as 10^{-3}, a test in the range 10^{-6} to 10^{-7} seems feasible, if the background and false-trigger problems can be solved by suitably optimizing the design of the detector. The detector uses a modest number (40 to 60) of wire planes and a fairly small spectrometer magnet (32 in. × 80 in. with an 8 in. gap). (auth)

51936 (TID–25473(Vol.4), pp 319-24) QUARK SEARCH. Leipuner, L. (Brookhaven National Lab., Upton, N. Y.).

An experiment is described which will detect quarks of $\frac{1}{3}$ or $\frac{2}{3}$ integral charge. The kinematics and some details of a detector are presented. (auth)

51937 PION, KAON, AND ANTIPROTON PRODUCTION BETWEEN 10 and 70 GeV. Wang, C. L. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Lett.; 25: 1068-72(12 Oct 1970).

A new scaling law and empirical formulas are presented for the double differential cross section of secondary production between 10 and 70 GeV. The 0° momentum spectrum is found to scale according to the square root of the incident momentum thus reflecting the importance of the c.m. system in the pionization process. It is pointed out that the 70-GeV production data of the Serpukhov-CERN collaboration experiment are very likely too low by a factor of ~2.5. (auth)

51938 NATURE OF TWO-MODEL ANGULAR DISTRIBUTION OF SHOWER PARTICLES IN THE 10 TO 20 GeV ENERGY REGION. Takibaev, Zh. S. (Inst. of Nuclear Physics, Alma-Ata, USSR). Dokl. Akad. Nauk SSSR; 186: 80-2(1 May 1969). (In Russian).

An attempt was made to show that the observed two modes are due to baryon or meson resonance particles. In order to determine the relation between the two modes and resonance particles studies (similar to cosmic-ray studies) were made using 700 proton–proton inelastic interactions at 10GeV/c which were recorded with 81-cm hydrogen chamber. Showers with $\sigma > 0.6$ and $D > 0$ were selected and their two modes were observed. Analysis of pion–nucleon showers at identical energy confirmed the results. Considering that in two-mode showers both protons cannot emit forward or backward the proton and pion were combined into a single system and its mass found. An analysis of four-prong π^-p interactions in an 81-cm hydrogen bubble chamber at 10 GeV enabled one to find the relation between two modes and productions of resonance particles. Eight hundred and eighty three four-prong interactions were studied. Four-prong π^-p interactions with neutral and with one-neutral particle were studied: $\pi^-p \rightarrow \pi^-p\pi^-\pi^+$, $\rightarrow p\pi^-\pi^+\pi^-\pi^0$, $\rightarrow n\pi^-\pi^+\pi^-\pi^+$. (R.V.J.)

51939 MEASUREMENT OF THE Σ^+ LIFETIMES. Eisele, F.; Filthuth, H.; Hepp, V.; Presser, W.; Zech, G. (Univ., Heidelberg). Z. Phys.; 238: 372-8(1970).

From about 2×10^6 measured Σ^+ decay's produced by stopping K^- mesons in the 81 cm Saclay hydrogen bubble chamber about 140,000 $\Sigma^- \rightarrow n\pi^-$ and 20,000 $\Sigma^+ \rightarrow n\pi^+$ decays were selected for a lifetime measurement. We obtained: $\tau_{\Sigma^+} = (0.795 \pm 0.010) \times 10^{-10}$ sec $\tau_{\Sigma^+} = (1.485 \pm 0.022) \times 10^{-10}$ sec. (auth)

51940 NEUTRON–NUCLEUS TOTAL CROSS-SECTIONS BETWEEN 8 GeV/c AND 21 GeV/c. Engler, J. (Univ., Karlsruhe, Ger. Kernforschungszentrums, Karlsruhe, Ger.); Horn,

K.; Monnig, F.; (and others). Phys. Lett.; 32B: 716-19(14 Sep 1970).

Total cross sections for neutrons on Be, C, Al, Cu and Pb were measured to an accuracy of about 1% at average neutron momenta of 8, 11, 14 and 21 GeV/c. For all elements they drop smoothly by about 3% between 8 and 21 GeV/c, and have a momentum dependence similar to the pp and np total cross sections. Indeed if the cross sections are normalized to the np total cross section, no momentum dependence can be observed. The data are compared with calculations based on the Glauber model. (auth)

51941 Ξ SPECTROSCOPY. Yodh, G. B. (Univ. of Maryland, College Park). pp 165-97 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

All available experimental information on Ξ levels is reviewed. Four levels: Ξ(1530), Ξ(1820), Ξ(1933) and Ξ(2030) are shown to be well established. There exists reasonable evidence for two levels: Ξ(1636) and Ξ(2450) and less definite evidence for Ξ(2250). Other than mass and width, isotopic spin is known for Ξ(1530), Ξ(1820), Ξ(2030) and Ξ(2450) ($\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{2}$, and $\frac{1}{2}$ respectively); J^P is known for Ξ(1530) to be $\frac{3}{2}^+$; some preliminary information on J^P exists for Ξ(1820) and Ξ(1933) and no J^P information exists on the rest. Branching ratios are known only very crudely, the best being for Ξ(1820) and Ξ(1933) levels. The present knowledge is summarized. (auth)

51942 ELASTIC SCATTERING OF 600 MeV PROTONS FROM LIGHT NUCLEI. Boschitz, Edmund T. (Lewis Research Center, Cleveland). pp 288-96 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The results for the differential cross sections and polarization in elastic proton-proton, proton-deuteron, proton-helium-3, and proton-helium-4 scattering are presented. (J.F.P.)

51943 SMALL ANGLE NUCLEON–DEUTERON AND NUCLEON–NUCLEON SCATTERING. Dutton, L. M. C.; van der Raay, H. B. (Birmingham Univ., Eng.). pp 315-17 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Experiments are described for the study of p + p and p + d scattering in the angular range 20 to 70 mR in the laboratory system at incident momenta of 1.29 to 1.69 GeVc. Data were taken using a magnetic spectrometer with sonic spark chambers which defined the particle trajectories. The data were analyzed to yield the ratio of the real to the imaginary part of the spin independent forward scattering amplitude. (J.F.P.)

51944 HYPERNUCLEI. Gal, A. (Massachusetts Inst. of Tech., Cambridge. Hebrew Univ., Jerusalem). pp 516-23 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A review of hypernuclear physics is given. Topics discussed are lambda–proton final-state interactions, the hyperon–nucleon force and binding energies of lambda in hypernuclei, including nuclear matter, and s- and p-shell hypernuclei. Measurements in a helium bubble chamber are also briefly discussed. (J.F.P.)

51945 NUCLEAR INTERACTIONS AND STUDY OF UNSTABLE PARTICLES. Kuznetsov, A. A. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 524-32 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Some previous research on particle interactions is reported. Resonances in the Λ + p system, elastic π^-, ^{4}He scattering at 3.48 GeV/c, and the cross section of neutral strange particle production in 5.1 GeV/c π^-p interactions are summarized. (J.F.P.)

51946 THEORY OF RADIATIVE np CAPTURE. Adler, R. J.; Chertok, B. T.; Miller, H. C. (Virginia Polytechnic Inst. Blacksburg. American Univ., Washington, D. C.). pp 541-3 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The discrepancy between theoretical calculations and the experimental np capture cross section for thermal neutrons is discussed. This discrepancy is reduced using a previous phenomenological approach to calculate the pion exchange effect. The remaining discrepancy is considered due to excited nucleons in the deuteron. (J.F.P.)

51947 LOW ENERGY ANTIPROTON–PROTON ELASTIC SCATTERING. Spencer, D.; Edwards, D. N. (Liverpool Univ.). Nucl. Phys.; B19: 501-8(1970).

Differential cross sections for the elastic scattering of antiprotons on protons below 70 MeV are presented and compared with the predictions of various models. (auth)

51948 ANTIPROTON–PROTON ANNIHILATION AT 6.94 GeV/c LEADING TO EIGHT AND MORE PIONS. Bar-Nir, I.; Brandstetter, A.; Dagan, S.; (and others) (Tel-Aviv Univ., Israel). Nucl. Phys.; B20: 45-62(1970).

The $\bar{p}p$ annihilation into eight and more pions was studied at an incident momentum of 6.94 GeV/c. Cross sections, angular distributions and angular correlations are presented. The two and three pions invariant-mass distributions are discussed. (auth)

51949 KINEMATIC INTERPRETATION OF EXOTIC FORWARD Δ^- PRODUCTION IN pn → $\Delta^-p\pi^+$ AND pn → $\Delta^-\Delta^{++}$ AT HIGH ENERGY. Berger, Edmond L.; Morrow, Richard A. (Argonne National Lab., Ill.). Phys. Rev. Lett.; 25: 1136-9 (19 Oct 1970).

A nonexotic, kinematic interpretation of forward Δ^- production in the reactions pn → $\Delta^-p\pi^+$ and pn → $\Delta^-\Delta^{++}$ at high energy is provided. It is shown that forward production of Δ^- in $\Delta^-p\pi^+$ is mediated by a simple diagram which includes one-pion exchange plus low-energy, off-shell $\pi^-p \to \pi^+\Delta^-$ scattering. The final state $n\pi^-\Delta^{++}$ is produced by a similar one-pion–exchange diagram. The sum of these diagrams imitates pn → $\Delta^-\Delta^{++}$. This approach has the virtue of absolute normalization; both shapes of distributions and total cross sections are in excellent agreement with available data. Other reactions in which the same mechanism operates are discussed and tests of the scheme are proposed. (auth)

Strong (Meson-Induced)

Refer also to abstracts 50585, 50587–50589, 50591, 52098, and 52318.

51950 (CALT-68-274) STUDY OF K^+p INELASTIC CHANNELS. Barish, B. (California Inst. of Tech., Pasadena); Davies, D. (California Univ., Los Angeles); Borak, T.; (and others) (National Accelerator Lab., Batavia, Ill.). [1970]. 12p. (CONF-700806-39). Dep. CFSTI.

From 15th International Conference on High Energy Physics, Kiev, USSR.

Recent experiments have indicated the possible existence of a highly inelastic resonance in the P_{13} partial wave in K^+p scattering. A 400-K exposure was taken at the L.R.L. 25 in. H.B.C. to study the momentum dependence of inelastic channels in the K^+p system. The exposure consisted of seven K^+ momenta, equally spaced between 1.3 and 2.2 GeV/c. Partial cross sections are presented for final states corresponding to 4 prong and 2 prong + vee topologies. (auth)

51951 (N–70–31011) STUDY OF TWO-BODY STRONG INTERACTIONS OF ELEMENTARY PARTICLES. Final Technical Report, January 27, 1969–May 1, 1970. Rush, J. Edwin Jr. (Alabama Univ., Huntsville. Research Inst.). May 1970. 14p. (NASA-CR-110443). NTIS.

The processes positive-pion–proton yields positive-sigma–hyperon–positive-kaon, negative-pion–proton yields neutral-sigma–hyperon–neutral-kaon and negative-pion–proton yields negative–sigma-hyperon–positive-kaon were studied jointly in a manner similar to negative-pion–proton yields lamba-hyperon–neutral-kaon. Charge independence (isospin conservation) was used to relate the three processes by two independent isospin states. All available data below 2045-MeV center-of-mass energy were surveyed, and 451 data points (differential cross section or polarization) at about 20 different energies were selected for the final calculations. The energy limit was chosen to be one half-width above the mass of the F_{37} (1940) resonance. (auth)

51952 (NYO-2171-319) ρ–ω INTERFERENCE IN THE $\pi^-\pi^+$ DECAY MODE OF THE REACTION π^- + p → (ρ,ω) + n AT 2.3 GeV/c. Hagopian, S.; Hagopian, V. (Pennsylvania Univ., Philadelphia. Florida State Univ., Tallahassee); Bogart, E.; Selove, W. (Pennsylvania Univ., Philadelphia). [1970]. 12p. Dep. CFSTI.

In a sample of 8300 events of the type π^- + p → π^- + π^+ + n obtained from a hydrogen bubble chamber exposure taken at Princeton-Pennsylvania Accelerator significant ω → π^- + π^+ is observed

interfering almost perfectly constructively with the prominent decay of $\rho^0 \rightarrow \pi^- + \pi^+$. Assuming two Breit–Wigner type resonances for the ρ and ω, the interference phase is determined to be $-15° \pm 30°$. This phase is consistent with predictions of $\pi - B$ degeneracy using Reggepology. (auth)

51953 (TID–25473(Vol.4), pp 19–58) STUDY OF THE REACTION $\pi p \rightarrow \Delta\rho$ AT 50 GeV/c. Carrigan, R. A. Jr.; Key, A. W. (National Accelerator Lab., Batavia, Ill.); Fowler, E. C. (Brookhaven National Lab., Upton, N. Y. Duke Univ., Durham, N. C.); Prentice, J. D. (Toronto Univ. (Ontario)).

An experiment was designed to investigate the reaction $\pi^+ p \rightarrow \rho^0 \Delta^{0++}$ at a beam momentum of 50 GeV/c. The apparatus consists of a 4π detector surrounding the target region and a large downstream spectrometer with two magnets and interspersed wire planes. Both wire planes and a rapid-cycling bubble chamber are considered for the target region. For full acceptance of the downstream rho meson, the first magnet, with a field of 20 kG, has a field volume 2 m long, 2.32 m wide, and 0.86 m high; the second magnet, with a field of 40 kG, is 4 m long, 2.4 m wide, and 1.45 m high. The resulting apparatus has sufficient mass resolution to identify the unstable particle masses and give good $|t|$ resolution. (auth)

51954 (TID–25473(Vol.4), pp 67–70) ELASTIC SCATTERING OF 50 TO 150 GeV/c $\pi^\pm$, $K^\pm$, AND $p^\pm$ FROM PROTONS AT LARGE MOMENTUM TRANSFERS. Rubinstein, R. (Brookhaven National Lab., Upton, N. Y.).

The design of an apparatus for studying elastic scattering with large momentum transfers in the range 50–150 GeV/c is presented. (auth)

51955 (TID–25473(Vol.4), pp 71–5) SMALL-ANGLE CHARGE-EXCHANGE EXPERIMENTS. Kirz, J. (State Univ. of New York, Stony Brook).

An optical spark-chamber experiment is discussed to study $\pi^- p$, $K^- p$, and $\bar{p}p$ charge exchange reactions. The angular range $-t < 3$ (GeV/c)^2 is covered at 50 and 100 GeV/c. Expected rates are estimated from existing data around 10 GeV/c. About 150 hours of machine time are needed for testing and data taking. (auth)

51956 (TID–25473(Vol.4), pp 237–66) EXPERIMENTS TO STUDY MESON RESONANCES. Clark, A. R. (California Univ. [Berkeley]. Lawrence Radiation Lab.); Conforto, G. (Chicago Univ., Ill.); Kenney, V. P. (Notre Dame Univ., Ind.); Key, A. W. (National Accelerator Lab., Batavia, Ill.); Neal, H. A. (Indiana Univ., Bloomington); Pine, J. (California Inst. of Tech., Pasadena).

A bubble chamber-spark chamber-counter "hybrid" system, a counter-spark chamber system and a missing-mass spectrometer are discussed as possible approaches to the study of meson resonances at NAL energies. The basic reaction considered is $\pi + N \rightarrow \pi + \pi + \pi + N$. An attempt was made to limit the size and complexity of the apparatus required, so as to be appropriate for an experiment during the initial operation of the NAL accelerator. (auth)

51957 (TID–25473(Vol.4), pp 267–73) PROPOSAL FOR THE DETECTION AND CLASSIFICATION OF BOSONS OF HIGH MASS. Osborne, L. S. (Massachusetts Inst. of Tech., Cambridge).

An experiment to detect and measure the quantum numbers and decay modes of heavy mass bosons is proposed. The experiment utilizes a large 4π magnet of maximum size 2m × 2m × 7.5 m. Triggering and particle trajectory tracing is done with wire chambers in the magnet and downstream from it. It is shown that counting rates are reasonable for such an effort. (auth)

51958 (TID–25473(Vol.4), pp 275–9) PROPOSAL TO STUDY DIFFRACTION DISSOCIATION USING A HYBRID SPECTROMETER AND RAPID-CYCLING NEON BUBBLE CHAMBER. Reeder, D. D. (Wisconsin Univ., Madison).

An experiment is proposed to study diffraction dissociation using a hybrid detector consisting of a rapid-cycling Ne bubble chamber with a hydrogen target and a wire-chamber spectrometer. The system uniquely provides information on some aspects of diffraction dissociation and particle spectroscopy. (auth)

51959 (TID–25473(Vol.4), pp 281–9) STUDY OF DIFFRACTIVELY PRODUCED MESONS AT NAL. Ascoli, G. (Illinois Univ., Urbana).

Some experimental aspects in studying diffractive production of boson resonances are discussed with particular reference to low momentum (100–300 MeV/c) proton recoil. The importance of a very large acceptance (~±45°) spectrometer is also emphasized as a crucial requirement for spin-parity studies. (auth)

51960 (TID–25473(Vol.4), pp 299–302) EXPERIMENT TO MEASURE PROPERTIES OF Y*'S PRODUCED AT HIGH ENERGIES. Ballam, J. (Stanford Linear Accelerator Center, Calif.).

A simple experiment is proposed in which Y* production is examined in a rapid-cycling chamber whose lights are triggered by a spark-chamber spectrometer. It is shown that it is possible to consider experiments in which the detection level is on the order of 2000 events/μb. (auth)

51961 (UCRL–19845) STRANGE PARTICLE PRODUCTION IN $\pi^+ p$ INTERACTIONS NEAR 3.7 GeV/c. Butler, William Ralph (California Univ., Berkeley. Lawrence Radiation Lab.). 29 May 1970. Contract W–7405–eng–48. 76p. Dep. NTIS.

Thesis.

Cross sections are presented for both stable and resonant strange particle final states produced by the interactions of positive pions in hydrogen. The data are taken from several incident momenta between 3.56 GeV/c and 3.82 GeV/c. The overall strange particle cross section is found to be about 1.5 mb. Two favorable tests of line reversal are presented by comparing $\pi^+ p \rightarrow Y^+ K^+$ with $K^- p \rightarrow Y^+ \pi^-$, where Y^+ first represents Σ^+ and then $\Sigma(1385)^+$. In a detailed study of the final state $p\pi^+ K\bar{K}$, it is found that $\sigma(\pi^+ p \rightarrow p\pi^+ \varphi) = 10 \pm 3$ μb, but $\sigma(\pi^+ p \rightarrow \Delta^{++} \varphi) \leq 2$ μb; both the Δ^{++} and the K*(890) are prominent structures in this four-body final state; the $K\bar{K}$ state occurring with the Δ^{++} is either $K_1 K_1$ of $K^+ K^-$ in even parity momentum states; however no threshold enhancement is associated with the Δ^{++}. (auth)

51962 PRECISE DETERMINATION OF THE $K_L - K_S$ MASS DIFFERENCE BY THE GAP METHOD (UNIVERSITY OF CHICAGO-UNIVERSITY OF ILLINOIS CHICAGO CIRCLE COLLABORATION). Aronson, S. H. (Univ. of Chicago); Ehrlich, R. D.; Hofer, H.; Jensen, D. A.; Swanson, R. A.; Telegdi, V. L.; Goldberg, H.; Solomon, J.; Fryberger, D. Phys. Rev. Lett.; 25: 1057-61(12 Oct 1970).

The $K_L - K_S$ mass difference, $\Delta m \equiv (M_L - M_S)c^2/\hbar$, was redetermined in a high-statistics experiment performed at the zero-gradient synchrotron of Argonne National Laboratory, using the "gap method" originally developed at Princeton. Two independent measurements, using B_4C and Cu, respectively, as regenerators, were performed and gave consistent results. Their mean is $\Delta m = (0.542 \pm 0.006) \times 10^{10}$ sec^{-1}. With this value, the result of our recent determination of arg η_+ by "vacuum regeneration" is recalculated to be $(44.7 \pm 5.0)°$, where the error allows for the uncertainty in Δm given above. (auth)

51963 ρ–ω INTERFERENCE IN THE $\pi^-\pi^+$ DECAY MODE OF THE REACTION $\pi^- + p \rightarrow (\rho, \omega) + n$ AT 2.3 GeV/c. Hagopian, S. (Univ. of Pennsylvania, Philadelphia); Hagopian, V.; Bogart, E.; Selove, W. Phys. Rev. Lett.; 25: 1050-3(12 Oct 1970).

In a sample of 8300 events of the type $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ obtained from a hydrogen bubble chamber exposure, a strong sharp $\omega \rightarrow \pi^- + \pi^+$ peak is observed. Analysis indicates that this $\omega \rightarrow 2\pi$ decay interferes almost perfectly constructively with the prominent decay of $\rho^0 \rightarrow \pi^- + \pi^+$. The interference phase is determined to be $-15 \pm 30°$. This phase is consistent with predictions of π–B degeneracy using Regge-pole methods. (auth)

51964 EVIDENCE THAT THE L-MESON HAS DECAY MODES OTHER THAN K*(1420)π. Bartsch, J. (Technische Hochschule, Aachen); Deutschmann, M.; Kraus, G.; (and others). Phys. Lett.; 33B: 186-8(28 Sep 1970).

It has been suggested that the (K$\pi\pi$) enhancement observed near 1780 MeV, the L-meson, can be explained as a threshold enhancement in the K* (1420)π system. Here quantitative evidence is presented from 10 GeV/c $K^- p$ interactions to show that this is not so and that the L-enhancement must have decay modes other than K* (1420)π. (auth)

51965 PARTIAL WAVE ANALYSIS OF THE REACTION $K^- n \rightarrow \pi^- \Lambda$ IN THE C.M. ENERGY REGION FROM 1900 MeV TO 2100 MeV. Cox, G. F. (Univ. of Birmingham, Eng.); Islam, G. S.; Colley, D. C.; (and others). Nucl. Phys.; B19: 61–84(1970).

Results are presented for a partial wave analysis of the reaction $K^- n \rightarrow \pi^- \Lambda$ covering a range of c.m. energies from 1900 to 2100 MeV. The events used were obtained from interactions of the type $K^- d \rightarrow \pi^- \Lambda p_s$. The analysis was performed both for a sample of events where p_s, the spectator proton from the deuteron, was seen, and for all events. Good agreement was found between the two sets of results. Values of the resonance parameters of the $\Sigma(2030)$ were determined, and some evidence was found supporting the existence of the F5 $\Sigma(1915)$. In addition, the P3 amplitude was found to be rapidly changing near 2100 MeV, consistent with a resonance in this wave at 1080 MeV. (auth)

51966 EXPERIMENTAL TESTS OF (ρ,A_2) AND (K*,K**) EXCHANGE DEGENERACY IN FORWARD MESON–BARYON SCATTERING. Lai, Kwan-wu; Louis, James (Brookhaven National Lab., Upton, N. Y.). Nucl. Phys.; B19: 205-23(1970).

The idea of exchange degeneracy of vector- and tensor-meson Regge trajectories was investigated experimentally for several pairs of reactions related by $s \longleftrightarrow u$ crossing. (auth)

51967 COMPARISON OF MODELS FOR NEUTRAL AND CHARGED PION MULTIPLICITIES OBSERVED IN 25 GeV/c π^-p COLLISIONS. Elbert, J. W.; Erwin, A. R.; Walker, W. D.; Waters, J. W. (Univ. of Wisconsin, Madison). Nucl. Phys.; B19: 85-92(1970).

Cross sections were obtained for events having a topology of 0 to 16 charged tracks and no strange particles in 25 GeV/c π^-p interactions. The average number of neutral pions, $\overline{n_\pi 0}$, for each topology was determined from a study of e^+e^- pairs converting in the hydrogen and in a Ta plate. Topological cross sections agree rather well with the multiperipheral model of Chew and Pignotti, with the conjecture of Wang on local production of pion pairs, or with a Poisson distribution of produced pions coupled with isospin independence. The latter model also successfully describes the number of charged tracks occurring with Λ^0K^0 and $\bar{K}^0K^0$. However, these models do not reproduce the measured values of $\overline{n_\pi 0}$. (auth)

51968 BEHAVIOR OF STRANGE PARTICLE CROSS SECTIONS IN π^-p COLLISIONS UP TO 25 GeV/c. Waters, J. W.; Walker, W. D.; Erwin, A. R.; Elbert, J. W. (Univ. of Wisconsin, Madison). Contract AT(11-1)-881. Nucl. Phys.; B17: 445-52(1970).

Strange particle production in π^-p collisions at 25 GeV/c is 4.0 ± 0.3 mb, approximately one event in every six. The size of this cross section implies significant exchange of particles with a mass equal to or less than ~500 MeV/c^2. About three-fourths of the cross section is due to K-pairs, and about half of these pairs have a net charge (e.g., K^+K^0 pairs). Copious production of an I = 1 resonance which decays into K-pairs could account for this. Since no such resonance is seen in the $K^0_1K^0_1$ mass spectrum, its G-parity would have to be even. (auth)

51969 QUANTUM NUMBERS OF LIGHT AND HEAVY A_2^- MESON DECAYING INTO π^- AND ρ^0 MESONS. Tikhomirov, G. D.; Vetlitskii, I. A.; Vladimirskii, V. V.; (and others) (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 12: 91-5(Jul 1970). (In Russian).

Results are presented on the analysis of left (A_2^L) and right (A_2^H) half of A_2^- meson produced in the reaction $\pi^-p \to \pi^-p\pi^+\pi^-$ at 3.25 GeV/c. Spin-parity analysis showed different quantum numbers of A_2^L and A_2^H meson. Preferred spin-parities of A_2^H meson are $J^P = 2^+$. A narrow grouping of events along the diagonal of the Dalitz plot for A_2^H meson is observed. (auth)

51970 STUDY OF THE PROCESS $\pi^- + p \to n + \gamma$ IN THE U CHANNEL AT p_{π^-} = 1.5 TO 3.8 GeV/c. Antopol'skii, V. D.; Bayatyan, G. L.; Emel'yanov, N. E. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 12: 96-100 (Jul 1970). (In Russian).

The reaction $\pi^- + p \to n + \gamma$ at large momentum transfers was investigated. The reaction products were detected by means of many-layer spark chambers. The kinematics was analyzed by measuring directions of the neutron and the γ-quantum emission, as well as the momentum vector of the incident pion. Data are obtained on the energy dependence of the cross section in the momentum interval 1.5 to 3.8 GeV/c for $\cos\theta^* = -0.99 \pm 0.01$. (auth)

51971 ANTIHYPERON AND ANTIPROTON PRODUCTION IN K^+p INTERACTIONS AT 9 GeV/c. Lissauer, D.; Alexander, G.; Firestone, A.; Goldhaber, G. (Univ. of California, Berkeley). Nucl. Phys.; B18: 491-504(1970).

The reactions of the type $K^+p \to \bar{Y}NN(\pi)$ were analyzed in K^+p interactions at 9 GeV/c, where $\bar{Y}$ refers to a $\bar{\Lambda}$ or $\bar{\Sigma}$ antihyperon. The production of $\bar{\Xi}^+$ in the reaction $K^+p \to \bar{\Xi}^+YN(\pi)$ and of antiprotons in the reaction $K^+p \to K^+p\bar{p}p$ was also studied. With twice the data previously reported a low-mass enhancement in the $\bar{\Lambda}N$ final state and also some indications of a similar enhancement in the non-exotic $\bar{\Sigma}^\pm N$ final states are observed. This enhancement has the quantum numbers of an I = ½ K^* resonance with mass M = 2240 ± 20 MeV and width Γ = 80 ± 20 MeV. (auth)

51972 K^+p INTERACTION FROM 864 TO 1585 MeV/c; ANGULAR DISTRIBUTIONS FOR INELASTIC SCATTERING. Bland, R. W.; Bowler, M. G.; Brown, J. L.; Goldhaber, G.; Goldhaber, S.; Kadyk, J. A.; Seeger, V. H.; Trilling, G. H. (Univ. of California, Berkeley). Nucl. Phys.; B18: 537-67 (1970).

Angular distributions are presented for production and decay of the quasi-two-body final states KΔ(1236) and K^*(891)p produced in K^+p interactions at 864, 969, 1207, 1367 and 1585 MeV/c. The analysis of these distributions leads to the following conclusions: (a) KΔ(1236) production near threshold is largely via P-waves and is, except for coupling constants, fairly well approximated at all momenta by the predictions of the Stodolsky–Sakurai ρ-exchange model; (b) K^*(891)p production appears dominated by vector exchange down to threshold, and no evidence of significant relative increase in pseudoscalar exchange contribution at low energy is seen; (c) study of the partial-wave structure of KΔ(1236) production shows no evidence of resonant behavior at the total cross-section peak near 1200 MeV/c. (auth)

51973 INVESTIGATION OF THE REACTIONS $\pi^-p \to \pi^-\pi^+$ AND $\pi^-p \to \pi^-\pi^0p$ AT 339 MeV. Blokhintseva, T. D.; Kravtsov, A. V.; Medvedev, V. I.; Poromov, V. I.; Sokolov, G. L.; Sherman, S. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 12: 101-8(Jul 1970). (In Russian).

There were 1200 events of the reaction $\pi^-p \to \pi^-\pi^+n$ and 152 events of the reaction $\pi^-p \to \pi^-\pi^0p$ detected in the hydrogen bubble chamber. The results of the analysis of the events are presented. A model is applied that uses the following channels: S production of the Δ isobar from the $D_{\frac{1}{2}}$ state, P production of the Δ isobar from the $P_{\frac{1}{2}}$ state, S production of the $N^*(\frac{1}{2}, \frac{1}{2})^-$ system from the $P_{\frac{1}{2}}^+$ state. Parameters for the model are determined by means of the least-square method. Using the obtained parameters, contributions from the noted channels to various $\pi p \to \pi\pi N$ reactions are determined. (auth)

51974 TRANSVERSE MOMENTA OF STRANGE PARTICLES PRODUCED IN PION INTERACTIONS WITH NUCLEI. Bederkin, A. T.; Mikhailichenko, V. I.; Ponosov, A. K.; Protasov, V. P.; Sergeev, F. M.; Sutugin, V. G. Yadern. Fiz.; 12: 109-11(Jul 1970). (In Russian).

Distributions on transverse momenta were studied for neutral strange particles generated by π^- mesons with momentum 3.86 GeV/c in the 105-cm freon bubble chamber. The experimental data are approximated by the distribution function $N(p_\perp)\,dp_\perp = Ap_\perp^n \exp(-Bp_\perp)dp_\perp$. (auth)

51975 INVESTIGATION OF $\pi^-\pi^-$ INTERACTION IN THE REACTION $\pi^-p \to N^{*++}(1236)\pi^-\pi^-$ AT 4.45 GeV/c. Beketov, G. V.; Zombkovskii, S. M.; Kaidalov, A. B.; Konovalov, B. S.; Kruchinin, S. P.; Selektor, Ya. M.; Shulyachenko, V. N. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 12: 112-21(Jul 1970). (In Russian).

The reaction $\pi^-p \to N^{*++}(1236)\pi^-\pi^-$ was investigated by means of the 50-cm hydrogen bubble chamber at the incident pion momentum of 4.45 GeV/c. The reaction was analyzed using the pion-Regge pole model and three one-pion exchange models. The $\pi^-\pi^-$ interaction cross sections are determined for the $(\pi^-\pi^-)$ effective masses from 0.28 up to 1.4 GeV. Angular distributions for the virtual $\pi^-\pi^-$ and π^+p scattering are presented. A background reaction $\pi^-p \to p\rho^0\pi^-$ is shown to affect the angular distributions substantially. (auth)

51976 DOMINANT PROCESSES IN THE REACTION $\pi^-p \to \pi^-\pi^-\pi^+p$ AT 3.9 GeV/c. Wohlmut, P. G.; Abe, K.; Johnson, A. D.; Stenger, V. J. (Univ. of Hawaii, Honolulu). Nucl. Phys.; B18: 505-29(1970).

New experimental results are reported for 7975 events of the type $\pi^-p \to \pi^-\pi^-\pi^+p$ at 3.9 GeV/c. A model based on pion exchange, rho exchange and diffraction dissociation is demonstrated to explain all the main features of the data. Only the relative amount of each of five dominant resonance production processes was varied in a maximum likelihood fit with no background assumed to the resonance amplitude in a given process. No form factors, absorption or off-mass-shell corrections were used. The model is consistent, by duality, with the multiperipheral models used at higher energies. Background resulting from the kinematic reflections of the competing processes is shown to produce profound effects. Diffraction dissociation is found to be equal in strength to pion exchange at this energy, and accounts for the $A_1(1070)$ enhancement in our data without a resonance pole. Evidence for the production of the resonant state $N^*(1460)$ by diffraction dissociation, and its cascade decay through $\Delta^{++}\pi^-$, is presented. (auth)

51977 CROSS SECTIONS OF FINAL STATES PRODUCED IN $\bar{K}N$ INTERACTIONS AT 3 GeV/c. Merrill, D. (CEN, Saclay, France); Barloutaud, R.; Duong Nhu Hoa; (and others). Nucl. Phys.; B18: 403-24(1970).

Cross sections of final states produced in K^-n interactions at 3 GeV/c are presented. The results, obtained in a 7 events/μb bubble chamber exposure with deuterium, are compared with results from an earlier K^-p exposure at the same incident K^- momentum. (auth)

51978 $\bar{K}N$ INTERACTION FROM 800 TO 1200 MeV/c. IV. CROSS SECTIONS OF K^-n REACTIONS. Armenteros, R. (CERN, Geneva); Baillon, P.; Lexa, P.; (and others). Nucl. Phys.; B18: 425-58(1970).

K^--neutron reactions were studied at eight different K^- momenta between 700 and 1175 MeV/c. Taking into account the Fermi motion of the neutron in the deuteron, this momentum

range corresponds to a mass range of the K^-n system between 1600 and 1900 MeV. 200,000 photographs with about 8 tracks/picture were taken in the 81 cm Saclay bubble chamber, filled with deuterium and exposed to a separated K^- beam at the CERN proton synchrotron. A total of about 34,000 events has been obtained. Analysis and cross sections of the main reactions are reported. (auth)

51979 INTERACTION CROSS SECTION OF THE Q^- ENHANCEMENT. Cnops, A. M. (Brookhaven National Lab., Upton, N. Y.); Huson, F. R.; Louttit, R. I.; (and others). Phys. Rev. Lett.; 25: 1132-5(19 Oct 1970).

Coherent production of $K^-\pi^+\pi^-$ systems by K^- beams on nuclei were observed, and the coherent production rate was measured in the Q(1300) region. Using the corresponding hydrogen and deuterium production rates σ_{Q^-}, the Q^--nucleon total cross section was calculated. It was found that $\sigma_{Q^-} = 20.8^{+1.1}_{-3.0}$ mb at 10 GeV/c and $\sigma_{Q^-} = 20.8^{+1.1}_{-3.0}$ mb at 12.7 GeV/c. (auth)

51980 EVIDENCE FOR $\rho-\omega$ INTERFERENCE EFFECT IN π^-p INTERACTIONS AT 3.9 GeV/c. Abramovich, M.; Blumenfeld, H.; Bruyant, F.; (and others) (CERN, Geneva). Nucl. Phys.; B20: 209-16(1970).

Evidence is presented for a constructive interference effect between the 2π decays of the ω and the ρ^0 observed in the reaction $\pi^-p \to p\pi^+\pi^-\pi^-$ at 3.9 GeV/c. From analysis of the $\pi^+\pi^-$ mass spectrum for the branching ratio $\Gamma(\omega \to \pi^+\pi^-)/\Gamma(\omega \to \pi^+\pi^-\pi^0)$ a lower limit of 1.1% is obtained at the 95% confidence level. (auth)

51981 K^+p ELASTIC SCATTERING AT 12.7 GeV/c. Jain, P. L. (State Univ of New York, Buffalo); Swissler, T.; Primer, M.; Shivpuri, R. K.; Evans, D.; Stone, S. L.; Ferbel, T.; Slattery, P. F.; Yuta, H. Nucl. Phys.; B19: 568-72(1970).

The elastic K^+p scattering cross section was measured at an incident K^+ beam momentum of 12.7 GeV/c. The experimental data for four-momentum transfers $-t \leq 3.5$ GeV^2 are well described by a distribution of the form $(d\sigma/dt)_0 \exp(At + Bt^2)$, with $(d\sigma/dt)_0 = 25^{+3}_{-1}$ mb/GeV^2, $A = 7.2 \pm 0.3$ GeV^{-2} and $B = 1.2 \pm 0.2$ GeV^{-4}. The cross section for scattering in the backward direction is 0.3 μb (one event). (auth)

51982 ANGULAR DISTRIBUTION AND POLARIZATION IN THE BACKWARD PEAK OF $\pi^-p \to \Lambda K^0$ AT 4 AND 6.2 GeV/c. Beusch, W. (CERN, Geneva); Michelini, A.; Websdale, D.; Fischer, W. E.; Frosch, R.; Muehlemann, P.; Pepin, M.; Polgar, E. E.; Codling, J.; Green, M. G. Nucl. Phys.; B19: 546-56(1970).

Data are presented on the backward peak in the reaction $\pi^-p \to \Lambda K^0$. 2950 events were observed at 4 GeV/c and 1080 at 6.2 GeV/c. The Λ-polarization rises very fast with decreasing u; it is already high at u = 0. (auth)

Particle Interactions and Properties (Theoretical)

Refer also to abstract 52691.

General

Refer also to abstract 52189.

51983 THREE BODY PROBLEM IN NUCLEAR AND PARTICLE PHYSICS. Proceedings of the First International Conference, Birmingham, England, 8–10 July 1969. McKee, J. S. C.; Rolph, P. M. (eds.). Amsterdam; North-Holland Publishing Company (1970). 574p. (CONF-690710).

The proceedings contain the text of 29 presented papers of which separate abstracts were prepared for 24. Five papers had appeared previously in NSA. Also reproduced are an Introductory Review by H. P. Noyes (Stanford Univ., California) and a closing Summary by R. E. Peierls (Oxford Univ.). Discussions are included together with abstracts of a number of submitted papers which were not presented. (UK)

For abstracts of individual papers see: 51984, 51985, 52005, 52058, 52069, 52070, 52115–52119, 52212, 52213, 52389–52396, 52417, 52651, and 52652.

51984 RESONANCE EXTINCTION IN THREE BODY FINAL STATE INTERACTIONS. Aitchison, I. J. R.; Graves-Morris, P. R. (Univ. of Kent, Canterbury, Eng.). pp 179-87 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

The absence of the rho resonance in the $\pi^+\pi^-$ subsystem of the $\pi^+\pi^-\pi^-$ final state produced by $\bar{p}n$ annihilation prompted the investigation of resonance extinction in final state interactions. Resonance extinction was shown to be a general feature of a simple dispersion theoretic model. The qualities of the two-particle amplitude necessary for a realistic three-particle amplitude which, in general, would not have resonance extinction, are discussed. One important factor was shown to be the structure of the vertex function, of which the significance was stressed by Amado and Noble. (5 references) (auth) (UK)

51985 RELATIVISTIC THREE-BODY PROBLEM. Blankenbecler, R. (Univ. of California, Santa Barbara). pp 448-59 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

The complexities of the relativistic three-body problem are pointed out. With regard to applications the most useful are in the scattering of high energy projectiles from two-particle bound states, both elastic and inelastic, and in three-particle decay modes of unstable particles. These processes are discussed, utilizing extensions of recent results developed for the two-particle scattering case. Among topics discussed are relativistic versions of the eikonal approximation for two- and three-body scattering processes, and the treatment of three-particle decay states by crossing the relevant two-particle scattering amplitudes. The treatment of processes such as high energy nucleon–deuteron, pion–deuteron and photon–deuteron scattering is complicated by the necessity of describing the bound state in a covariant manner. Since, for reasons of simplicity, it is preferable to describe bound states in terms of effective potentials for the Schroedinger equation it is desirable to formulate the problem in such a way that the relative motion of the projectile and the bound state is treated relativistically but the internal motion in nonrelativistic terms. This does not mean that the relativistic properties of the bound state are completely neglected, but rather that these corrections are contained in the "effective" potential. A detailed description of these treatments is presented. (19 references) (UK)

51986 NEW TESTS OF CENTER OF MASS HELICITY CONSERVATION IN DIFFRACTIVE PROCESSES. Cohen-Tannoudji, G.; G.; Drouffe, J. M.; Moussa, P.; Peschanski, R. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Phys. Lett.; 33B: 183-5(28 Sep 1970).

Very simple experimental tests of the assumption of center of mass helicity conservation in diffractive high energy processes are proposed. These tests can be applied even when the diffractively produced states do not have a well defined spin. (auth)

51987 SCALING AND THE ANGULAR DISTRIBUTION OF COSMIC RAY EVENTS. Bali, N. F.; Brown, L. S.; Peccei, R. D.; Pignotti, A. (Univ. of Washington, Seattle). Phys. Lett.; 33B: 175-8(28 Sep 1970).

The nature of the angular distribution of inclusive reactions that follows from the scaling hypothesis is discussed, and the prediction for the reaction $p + p \to \pi$ + anything at 250 GeV/c is compared with a new cosmic ray experiment. (auth)

51988 RELATIVISTIC SPIN: TOPS AND WAVE EQUATIONS. Schulman, L. S. (Indiana Univ., Bloomington). Nucl. Phys.: B18: 595-606(1970).

Angle, rotation and angular momentum take on additional complexity relativistically. Covariantly defined rotational coordinates — in fact, just three-dimensional top coordinates — are studied in classical and quantum mechanics. A wave equation, of a particularly simple form, for particles of arbitrary spin in the presence of an external electromagnetic field is presented. (auth)

51989 POLARIZATION OF PARTICLES WITH ARBITRARY SPIN. Gabos, Zoltan. Stud. Univ. Babes-Bolyai, Ser. Phys.; 15: 3-6(1970). (In French).

Matrix density structure for spin states in the case of coherent superposition of pure states is studied. It is shown that in the case of particles with spin s it is possible to obtain $4s^2$ of independent ratios of a given equation. Particles with singular spin can be described concretely by four relations between polarization parameters. (tr-auth)

51990 RELATIVISTIC EIKONAL APPROXIMATION. SCATTERING AND DISINTEGRATION OF DEUTERONS. Andreev, I. V.; Khoruzhii, V. Kh. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 12: 191-8(Jul 1970). (In Russian).

Relativistic field realization is constructed for the Glauber

approximation of additive phase shifts to the deuteron scattering. On this basis the limits of applicability of the approximation are considered. (auth)

51991 PION SCATTERING LENGTHS AND THE ρ-WIDTH. Mathur, V. S.; Olesen, P.; Rashid, M. A. (Univ. of Rochester, N. Y.). pp 29-37 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

The recent calculations of s-wave scattering lengths for the general process $\pi A \rightarrow \pi A$, where A is an arbitrary target are summarized. The results based on the models of ρ-dominance, current algebra and the Veneziano model are discussed in an attempt to bring out the inter-relation between them. A modified form of the KSRF relation, which lies at the heart of the comparison between these models, is also derived. (auth)

51992 REPRESENTATION OF QUARKS IN TERMS OF LINKED QUANTIZED FLUX LOOPS. Jehle, Herbert (George Washington Univ., Washington, D. C.). pp 97-113 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

A review of the connection between flux quantization and charge quantization formulated for a pair of interacting charged leptons is given. It is suggested how the manifold of elementary particles may be represented in terms of quantized magnetic flux loops. Linked elementary loops, neutrinos, photons, combination of elementary loops, and interactions between elementary loops are discussed. (J.F.P.)

51993 HIGH-ENERGY PHYSICS AND NUCLEAR STRUCTURE. Proceedings of the Third International Conference, New York, September 8–12, 1969. Devons, Samuel (ed.). New York; Plenum Press (1970). 896p. $37.50. (CONF-690914).

Separate abstracts are prepared for 120 of the 130 papers presented. The remaining nine papers previously appeared in NSA. For abstracts of these papers refer to a cumulative report number index under CONF-690914. (C.E.S.)

For abstracts of individual papers see: 50631, 51410–51413, 51894–51898, 51916, 51917, 51942–51946, 51994, 52019–52022, 52046–52048, 52059, 52099, 52134–52142, 52161, 52165, 52341–52350, 52402–52407, 52428–52448, 52494–52501, 52597–52608, and 52676–52700.

51994 GAUGE TRANSFORMATIONS AND GENERALIZED MULTIPOLE MOMENT OPERATORS. Lopes, J. Leite; Novello, Mario (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). pp 780-2 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

It is shown that the unitary implementation in Hilbert space corresponding to a space-time dependent gauge transformation $\Psi'(x) = e^{i\Lambda(x)}\Psi(x)$ is of the form $e^{-ij}\ \Psi(x)\ e^{ij} = e^{i\Lambda(x)}\Psi(x)$. (J.F.P.)

51995 INVARIANT EXPANSION OF SOLUTIONS OF DIRAC-TYPE RELATIVISTIC WAVE EQUATIONS. Atakishiev, N. M.; Verdiev, I. A. (Inst. of High-Energy Physics, Moscow). Teor. Mat. Fiz.; 4: 281-92(Sep 1970). (In Russian).

The expansion of the solutions of Dirac-type equations is obtained which makes it possible to perform the separation of variables. The general solutions for particles with spin 0, $\frac{1}{2}$, 1 and $\frac{3}{2}$ are given as well as the nonrelativistic limit of the complete system of functions on hyperboloid. (auth)

51996 REDUCTION OF THE KEMMER EQUATION AND THE SINGULAR BEHAVIOR OF INTEGER-SPIN RELATIVISTIC HAMILTONIANS. Seetharaman, M.; Jayaraman, J.; Mathews, P. M. (Univ. of Madras). Nucl. Phys.; B19: 625-31(1970).

A reduced form of the Kemmer equation for spin one particles is derived, wherein the wave function, which has no redundant components, transforms locally (unlike in earlier reductions). The reduced Hamiltonian is identical to the spin one specialization of the general integer-spin Hamiltonian obtained from recent investigations on second quantizable relativistic wave equations having the Hamiltonian form. It is an observation from the present analysis that while the reduced equation is well defined for the non-zero helicity projections of the wave function, the first time derivative of the zero helicity part of the reduced wave function is essentially undefined (much as if this part described a scalar particle). This helps to explain the "improper" nature of the general Hamiltonian for integer spin. (auth)

51997 HELICITY CROSSING RELATIONS BETWEEN THE TWO-BODY SCATTERING AND THREE-BODY DECAY CHANNELS. Jurkiewicz, J. (Jagellonian Univ., Krakow). Acta Phys. Pol.; B1: 217-25(Jul-Sep 1970).

The helicity crossing relations between the two-body scattering channels and the three-body decay channel are derived under the assumption that analytic properties of spinor amplitudes allow such a crossing. Each relation contains two or three crossing angles. (auth)

51998 STABILITY AND STRANGENESS OF SUBNUCLEAR PARTICLES. Lewis, D. T. (Government Chemists' Lab., London). Lab. Pract.; 19: 901-6(Sep 1970).

A three-entity theory for the generic structure of leptons, mesons, and baryons is developed. It is shown that the stability of the longlived hadrons may be predicted from parameters determining the internal angular momentum characteristics of subnuclear particles. A relation is suggested between the tamaid particle and the quark. On this basis the formation of the octet and decuplet groupings of the SU3 theory is shown to depend essentially on the multiplicity, spin and the tamaid number, the very strongly interacting hadronic forces negativing the electrostatic charge effects. (auth) (UK)

Electromagnetic

Refer also to abstracts 51894, 52174, and 52697.

51999 (AD–705700) MULTIPLE SCATTERING CORRECTIONS TO PION-PHOTOPRODUCTION. Benfatto, G.; Nicolo, F.; Rossi, G. C. (Rome Univ. (Italy). Istituto di Fisica). 18 Jun 1969. Contract F61052-67-C-0084. 36p. (NI–227; AFOSR–70–1230-TR). NTIS.

Following the idea of including in the scattering amplitudes absorption or multiple scattering corrections, a generalization of the Frautschi–Margolis model is proposed, in which, starting from Regge poles exchange, one generates multiple scattering corrections in the form of Regge cuts. A detailed application of the model to the high energy pion-photoproduction is explained and numerical results are given both for polarized and unpolarized differential cross sections, which are in agreement with experimental data. (auth)

52000 (JINR–E2-5347) PHOTON–PHOTON SCATTERING WITH COLLIDING e^+e^- BEAMS. [PART] I. Kunszt, Z.; Muradyan, R. M.; Ter-Antonyan, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1970. 20p. Dep. NTIS (U. S. Sales Only).

Photon-photon forward scattering is discussed by studying the annihilation process $e^+ + e^- \rightarrow \gamma +$ hadrons. Using automodality, vector meson dominance and the parton model a rough estimate is given of the deep inelastic cross section showing that it might be comparable to the cross section of the deep inelastic reaction $e^+ + e^- \rightarrow H +$ anything, H being a singled out hadron. Some of the one meson contributions are calculated in the quark model. (auth)

52001 (LNF–69/59) PROGRAM FOR CALCULATION OF PHOTOPRODUCTION OF SINGLE PIONS FROM NUCLEONS. Note No. 453. Nigro, M.; Spillantini, P.; Valente, V. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 14 Oct 1969. 13p. (In Italian). Dep. CFSTI (U. S. Sales Only).

A program was developed for the general case of the calculation of the magnitudes (cross section, production asymmetry, polarization of the recoil nucleon, etc.) in the single production of pions from nucleons. The development of the program is outlined. The logical block scheme and the list of the program is given together with a description of the input data and its use. An example is given of the use of the program. (J.S.R.)

52002 (LNF–70/20) T-INVARIANCE IN ELECTRON–DEUTERON ELASTIC SCATTERING. Note No. 476. Ferrara, S.; Grillo, A. F. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 19 May 1970. 5p. Dep. CFSTI (U. S. Sales Only).

It has been suggested that polarization in e–d scattering can be present in the absence of T-violation in the electromagnetic interaction if there is a phase between the S and D states of the deuteron. It is shown that, in the impulse approximation, time-reversal invariance in the electromagnetic transition of the deuteron implies that the phase is 0 to 180°. Since the recoil deuteron polarization is proportional to tan δ_{SD}, it is concluded that the presence of the vector polarization of itself implies a T-violation in the electromagnetic transition. (R.W.R.)

52003 (ORO–2504-159) BROKEN SCALE INVARIANCE AND KINEMATIC MOMENTS OF ELECTROPRODUCTION CROSS SEC-

TIONS. Technical Report No. 71-037. Budny, Robert (Maryland Univ., College Park. Dept. of Physics and Astronomy). Sep 1970. 9p. Dep. NTIS.

Expressions for high-energy limits of electroproduction cross sections weighted by $-q^2\omega$, $\omega\nu^{-2}$, and q^4 at constant s, θ, and ν respectively are derived from a previous broken scale invariance scheme. (auth)

52004 (TID-25473(Vol.1), pp 465-9) RANGE AND STRAGGLING OF MUONS. Wilson, R. R. (National Accelerator Lab., Batavia, Ill.).

The range of muons is calculated including radiation, pair production, and nuclear effects. It is shown that the large individual energy losses characteristic of these processes reduce the average range by a factor of ln 2 from that which one would get on the basis of simply integrating the average energy loss. The fractional straggling first increases as radiation and pair production effects become important and then decreases as the energy is further increased. (auth)

52005 RECENT DEVELOPMENTS IN THE INTEGRAL EQUATIONS TREATMENT OF THE FEW-BODY SCATTERING PROBLEM. Faddeev, L. D. (Mathematical Inst., Leningrad). pp 154-67 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

It is stated that the exact integral equations for the three-particle system seemed very impractical when first formulated, but several powerful approximate methods have since been developed. These include the method of two-dimensional integral equations and the Hilbert-Schmidt expansion of the two-body t-matrices, used primarily for the two-particle problem. Reliable quantitative characteristics of the three-particle system can now be obtained, given local short-range potentials. The situation is not so satisfactory for a system with a long-range interaction with Coulomb tails. It is tempting to use the integral equation for the Coulomb case since the exact expression for the corresponding two-body t-matrix is known; this, however, is not always possible, and the question is discussed in detail. An attempt is also made to "popularize" the integral equations for the N-particle case, obtained by Yacubovsky (Yadern. Phys. 5: 1313(1967)). Among matters discussed are the scattering problem for charged particles, and main points in the deviation of the integral equations for the N-particle system. (35 references) (UK)

52006 WHEELER-FEYNMAN ABSORBER THEORY OF RADIATION. Kamat, R. V. (Tata Inst. of Fundamental Research, Bombay). J. Phys., A (London); 3: 473-80(Sep 1970).

An attempt is made to re-derive the radiation damping formula using Wheeler-Feynman formalism of the absorber theory of radiation. The point of departure is that the absorber response on the radiating charged particle is calculated by taking into account the principle of action and reaction. (auth) (UK)

52007 PHOTON SPLITTING IN A STRONG MAGNETIC FIELD. Adler, S. L.; Bahcall, J. N.; Callan, C. G.; Rosenbluth, M. N. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev. Lett.; 25: 1061-5(12 Oct 1970).

The absorption coefficient and polarization selection rules are determined for photon splitting in a strong magnetic field, and the possible application of the results to pulsars is described. (auth)

52008 HIGH-ENERGY BACKWARD PION PHOTOPRODUCTION. Bajpai, R. P. (Univ. of Glasgow); Donnachie, A. Nucl. Phys.; B17: 453-60(1970).

Backward photoproduction of π^+ and π^0 at high energies is fitted with nondegenerate N_α, N_γ and Δ_δ Regge exchange. A good fit to the data is obtained with trajectory slopes of 0.89, 1.10, and 1.04 respectively. (auth)

52009 ON THE IMPORTANCE OF PION ELECTROPRODUCTION AT HIGH ENERGY. Sullivan, J. D. (CERN, Geneva. Univ. of Illinois, Urbana). Phys. Lett.; 33B: 179-82(28 Sep 1970).

High-energy pion electroproduction is analyzed and shown to be very useful as a source of the pion electromagnetic form factor and as a means of testing the vector dominance model and finite energy sum rule predictions for electromagnetic processes. (auth)

52010 COMPARISON OF u-CHANNEL ρ^0 PION PRODUCTION WITH THE ISOVECTOR PART OF π^+ PHOTOPRODUCTION. Guiragossian, Zaven G. T. (Stanford Univ., Calif.). Nucl. Phys.; B17: 634-40(1970).

The vector-dominance model predictions are used on the measurement of u-channel $\pi^-p \to \rho^0 n$ cross sections and a complete transversality system analysis on the ρ^0 spin density matrix elements. The photon isovector part in $\gamma p \to \pi^+ n$ is isolated using the u-channel cross-section measurements and a specific Regge-pole fit for the Δ, N_α and N_γ trajectory exchanges. Both results are compared to examine their consistency. (auth)

52011 SOME CONSTRAINTS OF CURRENT CONSERVATION ON TWO PARTICLE RADIATIVE SCATTERING. McGuire, J. H.; Malenka, B. J. (Northeastern Univ., Boston). Nucl. Phys.; B17: 641-52(1970).

The bremsstrahlung scattering amplitude is considered to lowest order in α for two spinless particles. It is shown that the purely off-mass-shell derivatives from the usual pole or external radiation terms cancel exactly with corresponding terms from the internal scattering amplitude to all orders in the photon momentum K. To order K^0, this is simply a form of the familiar low-energy theorem. Constraints for the on-shell as well as the mixed derivatives are derived. By using the constraints, the bremsstrahlung amplitude may be expressed in terms of internal scattering contributions and on-shell derivatives of the pole terms. (auth)

52012 VECTOR DOMINANCE AND FORWARD PHOTOPRODUCTION OF CHARGED PIONS. Dar, A. (Deutsches Elektronen-Synchrotron, Hamburg. Technion-Israel Inst. of Tech., Haifa). Nucl. Phys.; B19: 259-68(1970).

The validity of vector-meson dominance (VMD) relations between photon-initiated reactions and vector-meson-initiated reactions is investigated within the framework of realistic models for high-energy exchange reactions. The models suggest that the VMD relations should be valid at high enough energy, in the helicity frame. In particular the narrow forward structure that has been found in photon initiated reactions should be found also in the analogous hadron reactions, at high enough energy. (auth)

52013 INELASTIC ep SCATTERING IN THE POLARIZED CASE. Exner, Pavel (Charles Univ., Prague). Nucl. Phys.; B19: 42-50(1970).

The reaction $ep \to eN^*$ is studied in this work. The differential cross section is calculated using spin-tensor wave-function analysis in the case that the initial beam and the target are polarized and the polarization of the scattered electrons is detected. The cross section is a function of three form factors which correspond to the three types of transition in the lab system. The general form of the cross section for proton resonances is given here and detailed calculations are made for $N^*_{33}(1236)$ resonance with $J^P = {}^3/_2{}^+$. From this result it is possible to derive cross-section formula for $N^*_{\delta}(1525)$ resonance with $J^P = {}^3/_2{}^-$. A remark concerning the photoproduction of these resonances is also made. (auth)

52014 CONSPIRACY AND $\pi\Delta$ PHOTOPRODUCTION. Nelipa, N. F.; Zotov, N. P. (Lebedev Inst. of Physics, Moscow). Nucl. Phys.; B19: 51-60(1970).

$\pi\Delta$ photoproduction is considered within a framework of Regge pole model taking into account conspiracy relations (constraint equations) between scattering amplitudes at t = 0. Conspiracy and evasion solutions of constraint equations lead to different results both for differential $\pi\Delta$ photoproduction cross section and for density-matrix elements of Δ-resonance. The comparison with available experimental data indicates that for the case considered conspiracy is more preferable than evasion. (auth)

52015 PRODUCTION OF ω MESONS AT HIGH ENERGIES. Zhukarev, A. S.; Namsrai, Kh. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; No. 3, 19-23(May-Jun 1969). (In Russian).

Possible variations of peripheral model for simulating production of high energy ω mesons were analyzed. Calculations made for the photoproduction in peripheral model considering pion form factor and corrections on absorption were correlated with the computations made within the limits of photon dissociation. Calculations of $\pi + N \to \omega + N$ reaction used a model which took into account the instability of the exchange particle. It is shown that in the latter case the data on differential cross sections were not in such good agreement as the data obtained for the total cross sections. (tr-auth)

52016 DOUBLE-LOGARITHMIC ASYMPTOTICS OF THE ANNIHILATION AMPLITUDE $e^+e^- \to n\gamma$. Kuraev, E. A.; Kalinichenko, A. I. Yadern. Fiz.; 12: 122-8(Jul 1970). (In Russian).

The expression for the asymptotics of the annihilation amplitude of the electron-positron pair into arbitrary number of photons at high energies in cms is obtained provided that two hard photons in final state carrying out almost the whole energy of the pair are emitted in the directions of initial particles and other photons are emitted arbitrarily. The photons are polarized normal to the momenta e^+, e^-. (auth)

52017 MODEL FOR NUCLEON FORM FACTORS. Kuehnelt, H.; Stremnitzer, H. (Univ., Vienna). Nucl. Phys.; B18: 654-7 (1970).

A best fit of a recently derived expression for the electromagnetic nucleon form factors to experimental data has been made. For $|t| \geq 1.1$ $(GeV/c)^2$ an excellent fit has been achieved, which is a definite improvement over the dipole formula. The two mass values of a hypothetical ρ' vector meson which give the best fit are $m_{\rho'} = 1140 \pm 10$ MeV and $m_{\rho'} = 1910 \pm 6$ MeV. (auth)

52018 PHOTON M-FUNCTIONS. Fox, J. R. (Imperial Coll. of Science and Tech., London). Nucl. Phys.; B18: 577-84 (1970).

Antisymmetric tensor wave functions and corresponding tensor M-functions for photons and photonic processes are introduced. The tensor covariants, when partially contracted with the wave function, yield the usual gauge-invariant singularity-free vector covariants. (auth)

52019 PHOTOPRODUCTION OF LEPTON PAIRS FROM NUCLEI. Trefil, J. S. (Univ. of Illinois, Urbana). pp 98-100 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

It is shown that nuclear effects involved in the photoproduction of lepton pairs do not give rise to interference phenomena. The photoproduction of electron pairs on ^{12}C is studied as an example. (J.W.R.)

52020 INELASTIC INTERACTIONS OF PIONS AND NUCLEONS WITH NUCLEI AT HIGH AND SUPERHIGH ENERGIES. Barashenkov, V. S.; Gudima, K. K.; Eliseev, S. M.; Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 382-6 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A discussion of theory and experiment for cascade shower production in pion and nucleon reactions with nuclei at high and very high energies is given. A brief table is included comparing the results of the cascade calculations with experimental results. (J.F.P.)

52021 TOTAL PHOTOABSORPTION CROSS SECTIONS ON HYDROGEN AND COMPLEX NUCLEI AT ENERGIES UP TO 18 GeV. Caldwell, D. O. (Univ. of California, Santa Barbara); Elings, V. B.; Hesse, W. P.; Jahn, G. E.; Morrison, R. J.; Murphy, F. V.; Yount, D. E. pp 387-94 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Total cross sections for the photoproduction of hadrons from hydrogen, deuterium, carbon, copper, and lead were measured at energies below 18.3 GeV. This study gives information on the nature of the photon interactions. It is concluded that photons experience strong absorption and therefore do not behave as simple photons. (J.F.P.)

52022 π^0 DECAY. Adler, Stephen L. (Inst. for Advanced Study, Princeton, N. J.). pp 647-55 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690814.

Some recent theoretical work on $\pi^0 \rightarrow 2\gamma$ decay is described. This work helps to resolve puzzling questions which have arisen and may shed light on the nature of possible fundamental constituents of matter. (J.F.P.)

52023 ELECTROMAGNETIC MASS DIFFERENCE OF PIONS. Wakano, Masami (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 44: 296-7(Jul 1970).

The result of new calculations of the mass shift of pions is given based on the electromagnetic pion form factor. (J.F.P.)

52024 ELECTROMAGNETIC INELASTIC FORM FACTORS OF PROCESSES $ep \rightarrow eN^*$ IN A RELATIVISTIC EXTENDED PARTICLE MODEL BASED ON THE QUARK MODEL. Fujimura, Kimio; Kobayashi, Tsunehiro; Namiki, Mikio (Waseda Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 44: 193-218(Jul 1970).

The electromagnetic inelastic form factors of $ep \rightarrow eN^*$ are calculated in a covariant way, on the basis of a relativistic extended-particle model introduced as a straight-forward extension of the nonrelativistic quark model. It is shown that the inelastic form factors have the same q^2-dependence as the elastic one at higher momentum transfers, that is, $(d\sigma/d\Omega)_{inel}/(d\sigma/d\Omega)_{el} \rightarrow$ const for q^2 larger than the nucleon mass. This theoretical result, coming mainly from the Lorentz contraction of the nucleon as an extended particle, is consistent with recent experiment. The nucleon elastic form factors are also discussed in the same framework of the model. In particular it is shown that the neutron electric form factor appearing as a relativistic effect is consistent with existing experimental data. (auth)

52025 SCALING LAW FOR DEEP INELASTIC SCATTERING IN A NEW VENEZIANO-LIKE AMPLITUDE. Landshoff, P. V.; Polkinghorne, J. C. (Cambridge Univ., Eng.). Nucl. Phys.; B19: 432-44(1970).

A new Veneziano-like amplitude is constructed for two currents. It satisfies the Fubini-Gell-Mann sum rule with the same form factor as is obtained from the factored residue on the leading trajectory. This form factor can be given any desired rate of decrease at large momentum transfer. The Bjorken scaling law is satisfied and the amplitude can be used to construct a simple model for deep inelastic electron scattering on protons. The result is in qualitative agreement with experiment and the parameters of the model can be chosen to give a fair quantitative fit to the data. A more intricate version of the model is also developed which incorporates some of the effects of current conservation. A feature of these models is that they correlate the behavior of the structure function νW_2 near $\omega = 1$ with the rate of decrease of the form factor for large momentum transfer. (auth)

52026 ELECTROMAGNETIC INTERACTIONS OF WEAKLY-BOUND COMPOSITE SYSTEMS. Close, F. E. (Oxford Univ.); Copley, L. A. Nucl. Phys.; B19: 477-500(1970).

Relativistic definitions of c.m. and internal dynamical variables are obtained for a weakly bound, Lorentz invariant system containing an arbitrary number of particles. The method used is a generalization of the one developed by Osborn for the case of two-body systems. Once defined, the variables are used in a study of the interaction of composite systems with an external electromagnetic field. It is found that one obtains additional relativistic corrections to those usually included in such calculations. These corrections can be classified as being either spin dependent or spin independent. The importance of the former has previously been established. The importance of the latter is established here. Finally, it is shown that the Drell–Hearn Gerasimov sum rule can now be validated for an arbitrary, weakly-bound N-body system. (auth)

52027 η–X MIXING, $\eta \rightarrow 3\pi$ AND CHIRAL LAGRANGIANS. Osborn, H. (Univ. of Glasgow); Wallace, D. J. Nucl. Phys.; B20: 23-44(1970).

The problems associated with η–X mixing and $\eta \rightarrow 3\pi$ in a chiral Lagrangian framework, assuming a basic $(3,\bar{3}) + (\bar{3},3)$ symmetry breaking of SU(3) × SU(3) and that $\Delta I = 1$ electromagnetic processes are dominantly described by an effective u_3 type interaction, are reviewed. The X is introduced through a chiral singlet field in a general fashion into the Lagrangian. A relation is found between the processes $\eta \rightarrow 3\pi$, $X \rightarrow \eta\pi\pi$, and $X \rightarrow 3\pi$ and if the width of the X approaches the present experimental limit there could be significant enhancement in $\eta \rightarrow 3\pi$ so that the calculated rate agrees with experiment. The introduction of a singlet axial current so that the basic symmetry is U(3) × U(3) is discussed, but is shown to be invalid in the chiral Lagrangian framework with first-order symmetry breaking. The scale of the u_3 interaction is compared with baryon electromagnetic mass differences. The implied isospin violation in πN scattering length is calculated, and is found to be very small. (auth)

52028 EVALUATION OF CURRENT-ALGEBRA RELATIONS FOR ELECTROPRODUCTION AMPLITUDES. von Gehlen, G.; Schmidt, M. G. (Univ., Heidelberg). Nucl. Phys.; B20: 173-90 (1970).

Current algebra relations connecting electroproduction amplitudes and nucleon form factors are evaluated for momentum transfers up to 100 fm^{-2} using electroproduction amplitudes calculated from dispersion theory. Two methods are considered: First, the fixed mass extrapolation method of Adler and Gilman, and second the method of Fubini and Furlan, in which the electroproduction amplitudes are evaluated at the Breit-frame threshold. The Adler–Gilman extrapolation method is found to work quite well up to high values of λ^2, especially in case of the sum rules for $F_2^V(\lambda^2)$. The relation for $A_1^{(-)}$ gives some indication that the λ^2 dependence of the axial form factor is approximately given by $G_A(\lambda^2)/G_A(0) = F_1^V(\lambda^2)$. In contrast, the evaluation of the Fubini–Furlan relations turns out to be quite difficult. Information on the electroproduction amplitudes which goes beyond the Born approximation can only be obtained by a detailed knowledge of the correction integrals. Some predictions obtained by Furlan, Paver, and

Verzegnassi are different from what is expected from usual dispersion theory. (auth)

52029 SINGULARITIES OF CURRENT COMMUTATORS ON THE LIGHT CONE. Leutwyler, H. (CERN, Geneva); Stern, J. Nucl. Phys.; B20: 77-101(1970).

The forward proton matrix element of the electromagnetic current commutator is considered and its singularities on the light cone are expressed in terms of the scaling functions. This relation between the light cone and the deep inelastic region implies a family of sum rules for the electroproduction structure functions and connects the equal time commutators with the scaling functions. In particular the operator part of the Schwinger term and the related divergences of the electromagnetic mass of the proton are expressed in terms of measurable quantities. (auth)

52030 SUPERCONVERGENCE RELATIONS IN $\gamma N \to \pi\Delta(1236)$. Kloet, W. M.; Ragusa, S. (Instituto de Fisica Teorica, Sao Paulo, Brazil). Nucl. Phys.; B19: 645-52(1970).

Superconvergent amplitudes involving the isovector part of the photon in the process $\gamma N \to \pi\Delta(1236)$ are investigated. Assuming SU(3) symmetry for the $\Delta\Delta\gamma$ vertex, a relation is obtained between the $\Delta\Delta\pi$ and $NN\pi$ couplings, which is consistent with the SU(6) limit. For the physical masses of Δ and N this results in $g_{\Delta^{++}\Delta^{++}\pi^0} \approx 36$. (auth)

52031 PREDICTION OF ELECTROPRODUCTION MULTIPOLES. von Gehlen, G. (Univ., Heidelberg). Nucl. Phys.; B20: 102-24(1970).

Multipole equations which were obtained by projecting fixed-t dispersion relations are solved numerically for the coupled system of the seven multipoles $M_{l+}^{\frac{1}{2}}$, $E_{l+}^{\frac{1}{2}}$, $S_{l+}^{\frac{1}{2}}$, $E_{0+}^{\frac{3}{2}}$, $S_{0+}^{\frac{3}{2}}$. Seven values of the photon momentum transfer: 0, 5, 10, 20, 30, 50, and 100 fm^{-2} and two different assumptions for the pion form factor: $F_\pi = G_E^p$ and $F_\pi = F_1^V$ are considered. It is found that if the ambiguity in the solution for $M_{1+}^{\frac{3}{2}}$ is resolved by choosing the solution which goes fastest to zero at high energies (as has been proposed by Adler), the experimental cross sections as well reproduced for $\lambda^2 \geq 20$ fm^{-2}. The prediction for the S-wave multipoles indicates that the simple rule $E_{0+} \approx L_{0+}$ which has been used by several authors is not even approximately true for the physical multipoles. (auth)

52032 MODEL OF ENERGETIC ION PRODUCTION BY INTENSE ELECTRON BEAMS. Putnam, Sidney D. (Physics International Co., San Leandro, Calif.). Phys. Rev. Lett.; 25: 1129-32(19 Oct 1970).

Recent experiments with intense linear electron beams have produced ions with energies exceeding the beam kinetic energy. A localized beam-pinch model explaining the phenomena is presented. (auth)

52033 VENEZIANO-MODEL PREDICTIONS FOR THE REACTION $e^+e^- \to 2\pi^+2\pi^-$. Hopkinson, J. F. L.; Reya, E. (Daresbury Nuclear Physics Lab., Eng.). Lett. Nuovo Cim.; 4: 229-34(8 Aug 1970).

Veneziano model predictions obtained for the process $e^+ + e^- \to 2\pi^+ + 2\pi^-$ include the branching ratio, the four-pion form factors, the $\rho \to 4\pi$ amplitude, the total cross sections, and the effective coupling constant. Vector meson dominance with the ρ and ρ^1, where ρ^1 is on the first daughter trajectory, is assumed. (J.F.P.)

52034 NOTE ON ϕ PHOTOPRODUCTION AND THE NATURE OF THE POMERON. Weare, T. J. (McGill Univ., Montreal). Lett. Nuovo Cim.; 4: 251-58 Aug 1970).

Since the reaction $\gamma + p \to \phi + p$ is directly related to the reaction $\phi + p \to \phi + p$ if the vector dominance model holds, some data for the first reaction are analyzed in terms of the Frautschi-Margolis model for generating multiple Pomeron exchange with a view to suggesting definitive tests of this model. It is concluded that the Frautschi-Margolis multiple-scattering model when applied to the existing data on $\gamma + p \to \phi + p$ predicts that there should be a break in the slope of the differential cross section for $\phi + p \to \phi + p$ at about $t = 2.5$ (GeV/c)^2 and that the ratio of the real to the imaginary part of the forward amplitude for $\phi + p \to \phi + p$ should be small and positive. (J.F.P.)

Weak

52035 (TID-25473(Vol.4), pp 185-6) POLARIZATION EFFECTS IN MUOPRODUCTION OF W'S. Kirk, T.; Pipkin, F. (Harvard Univ. [Cambridge, Mass.]). Sculli, J. (National Accelerator Lab., Batavia, Ill.).

Relativistic leptons are left-handed in the V-A theory while negative muon beams are typically right-handed. The effect on W production by high-energy muons is discussed. (auth)

52036 (TID-25473(Vol.4), pp 227-30) FORM FACTOR DETERMINATION IN NEUTRINO INTERACTIONS. Palmer, R. (Brookhaven National Lab., Upton, N. Y.).

The energy dependence of the elastic cross section is expressed as a function of six form factors. The ability to separate the contributions of these form factors is discussed and the conclusion drawn that experiments should be performed in the neutrino energy region 0.5-5 GeV. (auth)

52037 NEUTRINO PROCESSES IN THE LEPTON ERA OF THE UNIVERSE. de Graaf, T. (Inst. of Theoretical Astronomy, Cambridge, Eng.). Lett. Nuovo Cim.; 4: 638-42(3 Oct 1970).

Among the properties of neutrino processes in the lepton era of the universe are the characteristic times, and the energy density for the total background of both kinds of neutrinos and antineutrinos. These calculations are based on the assumption that the universal Fermi interaction describes the weak-interaction processes considered. Also discussed are neutral lepton currents, nonconservation of lepton number, and diagonal interactions with a different coupling constant. (J.F.P.)

52038 WEAK INTERACTIONS WITH SCALAR INTERMEDIATE BOSONS. Patil, S. H. (Univ. of Delhi); Vaishya, J. S. Nucl. Phys.; B19: 338-46(1970).

A theory of weak interactions with scalar bosons is considered. It is pointed out that if the bosons couple to a triplet of scalar and pseudoscalar currents with unequal strength, a consistent theory is obtained, with weak parity and strangeness violations, and with effective octet structure for the strangeness-changing nonleptonic interaction. Higher-order weak and electromagnetic processes are evaluated under the assumption and the lowest order weak and electromagnetic processes are renormalizable and finite. The calculations for $K_L^0 \to \mu^+\mu^-$, $K^+ \to \pi^+\mu^+\mu^-$ and $K_1^0K_2^0$ mass difference yield consistent results for a scalar boson mass of about 10 GeV. (auth)

52039 TREATMENT OF CHARGE-DIVERGENCE COMMUTATORS AND APPLICATION TO THE $\pi K\kappa$ SYSTEM. Kraemmer, A. B. (Univ. of Copenhagen); Vilhjalmsson, T. Nucl. Phys.; B19: 269-85(1970).

A technique is developed for treating matrix elements of charge-divergence commutators between the vacuum and one-particle states. It is found that the charge-charge algebra and the asymptotic behavior of certain three-point functions determine special linear combinations of such matrix elements. This fact is used to obtain sum rules involving weak decay constants and form factors of π-, K- and the hypothetical κ-meson. Assuming pole dominated unsubtracted dispersion relations for the form factors, and using the experimental number, $f_K/f_\pi f_+(0) = 1.23$, and the known masses as input, all the above-mentioned parameters can be determined in the one-particle approximation. Among other results are found: $f_+(0) = 1$, $f_K/f_\pi = 1.23$ and $m_\kappa \approx 1100$ MeV. The commutators can be calculated in the frame of the model of Gell-Mann, Oakes and Renner. Almost all the previous results are found without assuming pole dominance in dispersion relations. The model parameter c is also determined to be $c = -1.27$. (auth)

52040 IMPLICATIONS OF THE EXISTENCE OF A HEAVY MUON-PROTON RESONANCE. De Rujula, A. (CERN, Geneva); Zia, R. K. P. Nucl. Phys.; B19: 224-36(1970).

An enhancement that might be due to a resonant effect has been experimentally found in the $\nu n \to \mu p$ processes. The implications of such an effect are reviewed in some detail. (auth)

52041 BOOTSTRAP EQUATIONS AND CABIBBO THEORY. Cronstroem, C.; Noga, M. (Univ. of Helsinki). Nucl. Phys.; B17: 477-88(1970).

The most general solutions are obtained to the c-number bootstrap equations, $a_i = cd_{ijk}(a_j a_k + b_j b_k)$ and $b_i = ed_{ijk}a_j b_k$, where the amplitudes a_i, b_i represent matrix elements of unitary octet vector and axial-vector charges, respectively, and c and e are arbitrary constants. For $e = 2c$, the equations have solutions which are consistent both with a one- and two-angle Cabibbo theory. The solutions with all physical requirements imposed still depend on three free parameters in addition to the scaling factor c. If $e \neq 2c$, then the equations have no CP conserving solutions which satisfy all the requirements of Cabibbo theory. (auth)

52042 CALCULATED CROSS-SECTIONS FOR NEUTRINO PRODUCTION OF THE INTERMEDIATE BOSON. Chen, H. H. (Univ. of California, Irvine). Nuovo Cim.; 69A: 585-612(21 Oct 1970).

Cross sections for neutrino production of the (hypothetical) intermediate boson of weak interactions, the W-boson, are calculated. The W-boson production reactions $\nu_l + N \to l + W + N^*$ and $\nu_l + N \to l + W + \Gamma$, where l is a charged lepton (electron or muon) and ν_l its corresponding neutrino; N, a nucleon; N^*, a

nucleon resonance; and Γ, a nonresonant nucleon state, are considered in addition to the reactions $\nu_l + N \rightarrow l + W + N$, and $\nu_l + Z \rightarrow l + W + Z$, where Z is a nucleus of charge Z. The cross sections are calculated up to large incident-neutrino energies, i.e. to regions where these (nonasymptotic) cross sections increase ~ proportional to E_ν, the incident-neutrino energy. Cross sections up to this energy region are necessary for deducing a reliable lower limit on M_W, the W-boson mass, from the observation of a horizontal flux of muons deep underground. (auth)

52043 ELECTRON–MUON UNIVERSALITY IN STRANGENESS-CHANGING PROCESSES. Rajasekaran, G.; Sarma, K. V. L. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys.; B18: 568-76(1970).

It is suggested that the available data are consistent with the hypothesis that the electronic and the muonic weak currents have slightly different couplings to the strangeness-changing hadronic current. The consequences of such a weak violation of the e-μ universality are studied with particular reference to the problem of the e-μ mass difference and the Cabibbo-angle determination. (auth)

52044 W-BOSON PRODUCTION IN REACTION $\nu N \rightarrow \mu WN$ + (HADRONS). Folomeshkin, V. N. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 12: 129-32(Jul 1970). (In Russian).

Cross section of reactions $\nu N \rightarrow \mu WN$ + (hadrons) and $\nu p \rightarrow \mu Wp$ for W boson masses equal to 2, 4, 6, 8 GeV is calculated. The cross section of reaction $\nu N \rightarrow \mu WN$ + (hadrons) is considerably larger (especially at large values of the W-boson mass) than that of reaction $\nu N \rightarrow \mu WN$. (auth)

52045 METHOD TO SEPARATE NUCLEAR EFFECTS IN NEUTRINO EXPERIMENTS. Belavin, A. A.; Gurvits, S. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 12: 133-8(Jul 1970). (In Russian).

The problem is how to obtain information on the elastic neutrino–nucleon interaction from the quasielastic reactions on nuclei: $\nu + A \rightarrow A' + p + \mu^-$. The nuclear effects may be separated by means of comparison of the neutrino reaction with the pion reaction $\pi^- + A \rightarrow A' + p + \pi^0$. (auth)

52046 WEAK INTERACTIONS OF PIONS AND MUONS. Wolfenstein, Lincoln (Carnegie-Mellon Univ., Pittsburgh). pp 661-74 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The discussion of weak interactions of pions and muons covers the basic assumptions of weak interaction theory, partially conserved axial current, some problems in weak interaction theory, muon decay, pion decay, and muon capture. (J.F.P.)

52047 EXPERIMENTAL TESTS OF MODELS OF THE WEAK HAMILTONIAN. Fischbach, Ephraim (State Univ. of New York, Stony Brook); Tadic, Dubravko; Trabert, Kenneth. pp 742-50 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Some of the ideas underlying various attempts to discriminate among models of the weak Hamiltonian density through the study of parity-violating nuclear interactions are clarified. (J.F.P.)

52048 ANGULAR MOMENTUM NONCONSERVATION SCHEME. Selleri, Franco (Univ., Bari, Italy. INFN, Bari, Italy). pp 751-8 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The question of whether angular momentum nonconservation can be compatible with Lorentz invariance is answered using a noninvariant vacuum and the indefinite metric. The possibility of angular momentum nonconservating transitions is shown in the decay $K \rightarrow 2\pi$, where K is assumed to have spin ½. (J.F.P.)

52049 NONLEPTONIC WEAK DECAY PROCESSES. Overseth, O. E. (Univ. of Michigan, Ann Arbor). pp 213-24 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

The current experimental situation regarding the nonleptonic decays is reviewed. Restriction is made to the CP conserving nonleptonic decays, and emphasis is given to the $\Delta I = 3/2$ rule. (J.F.P.)

52050 POSSIBLE EXISTENCE OF SPIN-0 W^{+-} AND SOME OF ITS EXPERIMENTAL CONSEQUENCES. Lee, T. D. (Columbia Univ., New York). Phys. Rev. Lett.; 25: 1144-7(19 Oct 1970).

The theoretical possibility that there may exist charged spin-0 weak intermediate bosons, in addition to the usual spin-1 intermediate bosons, is discussed. Some of its experimental consequences are analyzed. (auth)

52051 COMMENT ON VIOLATION OF THE $\Delta I = 1/2$ RULE IN $K \rightarrow 3\pi$ DECAY. Kellett, B. H. (Univ. of Manchester, Eng.). Nucl. Phys.; B19: 373-80(1970).

The present experimental situation with respect to the structure of the matrix elements for τ and τ′ decay is investigated. It is found that the data can be interpreted in a way that is consistent with the $\Delta I = 1/2$ rule. (auth)

52052 DECAY $K_1^0 \rightarrow \pi^0 e^+ e^-$ AND THE ELECTROMAGNETIC RADIUS OF THE NEUTRAL K-MESON. Sehgal, L. M. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys.; B19: 445-9(1970).

An estimate is made of the decay rate of $K_1^0 \rightarrow \pi^0 e^+ e^-$ in terms of the mean-square charge radius $\langle r^2 \rangle$ of the neutral K-meson. Assuming for $\langle r^2 \rangle$ the value predicted by vector-meson dominance, the ratio $\Gamma(K_1^0 \rightarrow \pi^0 e^+ e^-)/\Gamma(K_1^0 \rightarrow \pi^+ \pi^-)$ is found to be 8×10^{-6}. The background from the decay $K_2^0 \rightarrow \pi^0 e^+ e^-$ is also estimated, and arguments are given to show that $\Gamma(K_2^0 \rightarrow \pi^0 e^+ e^-)/\Gamma(K_1^0 \rightarrow \pi^0 e^+ e^-) \lesssim 10^{-4}$. (auth)

Strong (General)

Refer also to abstracts 52095 and 52166.

52053 (N-70-29877) THEORY OF RELATIVISTIC SUPERMULTIPLETS. PART 2. PERIODICITIES IN HADRON SPECTROSCOPY. Kursunoglu, Behram (Miami Univ., Coral Gables, Fla. Center for Theoretical Studies). Dec 1969. 78p. (NASA-CR-110359; CTS-HE-69-5). NTIS.

The theory for all fundamental particles proposed earlier is further discussed and the higher hadron supermultiplets and the corresponding mass levels of the various spins and parities are calculated. The results of the theory and the experimental data on hadron masses are found to be in excellent accord. The parities of the particles are obtained unambiguously and the theory predicts 2(−) and higher-spin mesons in addition to known ones. Higher-spin massive and massless leptons are also predicted. The most fundamental feature of the wave equation is the prediction of a periodicity in the hadron and lepton spectra. No two baryons or two mesons can occupy the same state and therefore their wave functions must be antisymmetric with respect to an interchange of their respective quantum numbers. A further consequence is the prediction of integral spin leptons. (auth)

52054 CONSTRAINTS ON DECAY DISTRIBUTIONS OF RESONANCES DERIVED FROM A SIMPLE REGGE-POLE MODEL. Maor, Uri (Univ. of California, Berkeley). Nucl. Phys.; B19: 20-8(1970).

Constraints on the decay angular distributions of resonances produced in quasi-two-body reactions are deduced from a simple Regge-pole model. It is shown that these relations are derived from a specific choice of Regge-trajectory couplings. The same correlations were obtained also from a quark model, and it is argued that the corresponding experimental study of resonance decay distributions does not provide a meaningful test of the quark model. A discussion on the applicability and limitations of these results is given. (auth)

52055 DUALITY FUNCTIONS IN A MESON–BARYON MODEL. Fairlie, D. B.; Jones, K. (Univ. of Durham, Eng.). Nucl. Phys.; B17: 653-60(1970).

Duality functions, i.e., constraints on the integration variables in a multi-channel representation of the Veneziano form are developed for the multiparticle amplitude describing the emission (or absorption) of n elementary mesons by a baryon with an isobaric spectrum. The sequence of graphs related by duality consists of all distinct permutations of the order of absorption of the mesons by the baryon, and the resulting amplitude is expressible in terms of the resonance poles associated with any one of them. This is the generalization of a model proposed by Burnett and Schwarz. This model has also recently been generalized in a completely different direction by Mandelstam. (auth)

52056 HIGH-SPIN DUAL VERTEX AND TOTAL WIDTHS ON THE LEADING TRAJECTORY. Gallardo, J. C.; Galli, E. J. (Yeshiva Univ., New York). Nuovo Cim.; 69A: 651-64(21 Oct (1970).

A general three-resonance dual vertex with one of the legs being

a normal-parity spin-j particle (leading trajectory) is constructed assuming a local coupling with the current carried by the constituents, quarks, of a hadron. This leads to results similar to those obtained by factorization of the N-point dual amplitude. This vertex is used to study the total widths of resonances along the leading trajectory. An explicit numerical computation of the first four widths was carried out. One cannot make yet any statement about the asymptotic behavior of the widths but the results are not in disagreement with experimental indications, namely they slowly decrease as a function of M^2 in the energy region considered. (auth)

52057 INTERACTION OF BOSON REGGE POLES WITH POMERANCHUK POLE. Gribov, V. N.; Levin, E. M.; Migdal, A. A. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz.; 12: 173-90(Jul 1970). (In Russian).

The problem of stability of the boson Regge poles (β) is considered on basis of the reggeon diagram techniques and the stability of the Pomeranchuk α pole. Under some conditions it is proved that r, the amplitude of the decay $\beta \to \beta + \alpha$, vanishes; however, a solution with $r \neq 0$ and fast moving pole $\beta(t) = \beta(0) + r\sqrt{t}$ is possible in principle. If r = 0 (the quasistable poles) then the dominating role is attributed to the decays $\beta \to \beta + 2\alpha$, the result is that the slope of the β-pole trajectory depends on ln t: $\beta'(t) = \beta'(0)[1 - c(\ln t)^{-3}]$. In both the solutions partial amplitudes are determined by the enhanced diagrams and have anomalous singularities in the complex j plane, besides the Mandelstam singularities. Angular distributions at superhigh energies ($\ln s \gg 1$) corresponding to unstable ($r \neq 0$) and quasistable ($r = 0$) β-poles are investigated. In the case $r \neq 0$ a new diffractional radius, $R_\delta = r \ln s$, arises, besides the usual one, $R_\alpha = \sqrt{\alpha' \ln s}$. (auth)

52058 CHANGE IN A TWO-PARTICLE RESONANCE REQUIRED TO EFFECT A CHANGE IN A THREE-PARTICLE RESONANCE. Riordan, Frank (Birmingham Univ., Eng.). pp 319-31 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

An exact expression is derived, within the framework of the Faddeev equations, for effecting a change in the position of a three-particle resonance by changing the position and phase shift of one of the resonances in a two-particle subsystem. This expression involves the resonance vertex functions the momentum of the first, second or third particle when the other two are at a resonance energy, the original two-particle potential, the eigen function of the Faddeev kernel and the three free particle Green's function. A relativistic version is established within the formalism of analytic S-matrix theory. (2 references) (UK)

52059 COHERENT AND INCOHERENT PARTICLE PRODUCTION IN NUCLEI. Margolis, B. (McGill Univ., Montreal). pp 430-9 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Coherent and incoherent particle production in nuclei is studied using coupled equations in an optical model. Photoinduced reactions are also considered. (J.F.P.)

52060 SPIN OF THE QUARK. Franklin, Jerrold (Temple Univ., Philadelphia). pp 139-46 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

It is pointed out that the spin of the quark is of interest and that it need not be ½. The advantages and disadvantages of high-spin quarks are summarized. It is concluded that there is no compelling evidence for any particular quark spin. (J.F.P.)

52061 QUARK MODEL AS A GUIDE TO HADRON DYNAMICS. Lipkin, Harry J. (Weizmann Inst. of Science, Rehovot, Israel). pp 239-68 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

The discussion of the quark model as a guide to hadron dynamics covers duality, the quark model, and the two-component theory of total cross sections, the implications of the absence of exotic states, physics in counting quarks, and decay correlations in the quark model. Also covered are the connection between quark and peripheral models and the algebraic structure of the quark model. (J.F.P.)

52062 QUARK MODEL AND THE FACTORIZATION OF THE VENEZIANO AMPLITUDE. Nambu, Yoichiro (Univ. of Chicago). pp 269-78 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

A quantitative and precise fusion of the quark model and the analytic structure of the Veneziano representation are discussed. A self-consistent factorizable set of Veneziano-type amplitudes is found for all hadronic processes. Spins are ignored, and an n-point Veneziano function for neutral scalar particles is considered. (J.F.P.)

52063 VARIANTS OF THE QUARK MODEL. Lichtenberg, D. B. (Indiana Univ., Bloomington). pp 279-89 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

Models are discussed which are quarklike in the sense that they contain at least one fundamental triplet of SU(3). Several ways of overcoming the problems of fractional charge and quark statistics are described. This is done at the expense of making the model more complicated. It is noted that many of the other problems of the quark model still exist in the variant models. (J.F.P.)

52064 SIGNIFICANCE OF MULTIPLE SCATTERING FOR THE QUARK MODEL. Pagnamenta, Antonio (Rutgers-The State Univ., New Brunswick, N. J.). pp 291-312 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

Recent work done on multiple scattering in the quark model is reviewed systematically with a special emphasis on its significance for the model itself. It is shown that excellent fits and predictions can be obtained from the SU(3) quark model but that alternative models can also but perhaps not as easily fit the data. The review includes work on differential cross sections, total cross section sum rules, processes requiring double scattering, isobar excitation and the relation to Regge theory. (auth)

52065 SOME COMMENTS ON THE QUARK MODEL. Dalitz, R. H. (Oxford Univ.). pp 355-401 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

The review of the quark model covers the quark field theory, the naive quark model, the baryonic states including supermultiplets, mass splittings and mixing of states, supermultiplet decay modes, and exotic states. The mesonic states are discussed and cover the supermultiplets and the split A_2 meson. The deep inelastic excitations due to electron and neutrino interactions at high energy are also considered. (J.F.P.)

52066 INELASTIC DIFFERENTIAL CROSS SECTIONS AT HIGH ENERGIES AND DUALITY. Kancheli, O. V. (Inst. of Physics, Tbilisi, USSR). JETP Lett. (USSR) (Engl. Transl.); 11: 267-70(20 Apr 1970).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu; 11: 397-400(20 Apr 1970).

The collision of two hadrons with 4-momenta p_a and p_b is considered, the collision resulting in the production of one particle with 4-momentum p and a beam of an arbitrary number of particles with total mass $v^{1/2}$, where $v = (p_a + p_b - p)^2$. If $s = (p_a + p_b)^2 \gg m^2$ and $s \gg v$, then the total differential cross section $d^2\sigma/dp^2$ of such a process can be expressed in terms of the amplitude $U_{\alpha_1\alpha_2}$ for the scattering of a reggeon by a particle. Under the assumption that $U_{\alpha_1\alpha_2}$ has dual properties a number of conclusions concerning $d^2\sigma/dp^2$ are drawn. The advantage of the non-diffraction processes for the study of the production of heavy resonances at large values of s by the missing-mass method is pointed out: the ratio σ(resonances)/σ(backgr.) is small in diffraction reactions and is not small in non-diffraction reactions. (R.W.R.)

52067 RELATIONS BETWEEN THE DIFFERENTIAL CROSS SECTIONS IN THE REGION OF THE SECOND DIFFRACTION MAXIMUM IN THE SU_3 QUARK MODEL. Gula, A. (Inst. of Nuclear Techniques, Krakow). Acta Phys. Pol.; B1: 211-16 (Jul-Sep 1970).

The assumption of antiquark-quark scattering dominance in the formation of the second diffraction maximum is used to obtain relations between the differential cross sections in the angular region of the secondary maximum in the framework of the addi-

tive quark model with spin. Some of the relations are compared with experimental data. (auth)

Strong (Baryon No. = 0)

Refer also to abstracts 51947, 52104, 52175, and 52350.

52068 (COO-264-557) DUAL RESONANCE MODEL WITH QUARK SPIN. Yoshimura, Motohiko (Chicago Univ., Ill.). Aug 1970. Contract AT(11-1)-264. 37p. (EFI-70-45). Dep. NTIS.

A dual resonance model with nontrivial quark spin factors is presented. An amplitude is found which satisfies factorization and eliminates the parity doubling ghosts. An application to $\pi\pi$ elastic scattering indicates that the positivity condition is not met on the first daughter trajectory if one assumes realistic values for the mass and intercept. (auth)

52069 APPLICATION OF THE QUASI-PARTICLE METHOD TO THE THREE-BODY PROBLEM: CALCULATIONS FOR A MODEL WITH LOCAL POTENTIALS. Alt, E. O.; Grassberger, P.; Wandhas, W. (Univ., Bonn). pp 275-90 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

The quasiparticle concept introduced by Weinberg for two-particle scattering has recently been applied to the three-body problem. It leads to an exact representation of the scattering matrix in terms of a modified Born series, the lowest order of which yields the widely used separable potential approximation. To test this method the binding energies of three identical spinless particles interacting via Yukawa potentials, and the elastic scattering of one particle off a bound state of the other two, are calculated in zeroth and first order quasi-Born approximation. The calculation shows that the inclusion of the first quasi-Born correction greatly improves the zeroth order (separable potential) results. Comparison is also made with other calculations recently performed in this model. (26 references) (auth) (UK)

52070 THREE-MESON RESONANCE FROM FADDEEV TYPE EQUATIONS. Pasquier, J. Y. (Laboratorie de Physique Theorique et Hautes Energies, Orsay, France); Pasquier, R. pp 460-9 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

It is stated that the relativistic extensions of the Faddeev equations provide one of the simplest and most attractive tools for making predictions about three meson systems. They have three-body unitarity built in, and when the input two-body off-shell amplitudes are approximated by a separable form, the matrix elements satisfy one-dimensional integral equations which are tractable numerically on a computer. The lack of information about off-shell form factors entering the two-body separable amplitudes however, leaves a wide freedom for their choice and made it seem worthwhile to try a phenomenological analysis with simple parameterizations, followed by a separation of those properties of the three-body system that are relatively independent of the undetermined parameters of the form factors from those that crucially depend on them. This was attempted by considering first a simplified approach for the $\bar{\Lambda}\Lambda\Lambda$ and $\bar{K}K\Lambda$ systems, assuming the $\bar{\Lambda}\Lambda$ and $K\bar{\Lambda}$ amplitudes to be dominated by the ρ (765 HeV) and K* (890 MeV) resonances, respectively. Subsequently the $K\bar{\Lambda}\Lambda$ system, which involves these two resonances simultaneously, was considered. It is concluded that the model might be useful for identifying some of the numerous experimental resonance recognized. It was considered remarkable that the quantum numbers of the main resonances obtained do not appear to depend on the choice of form factors. Quantitative agreement was found with results previously obtained within a dispersive Khuri-Treiman type model. (5 references) (UK)

52071 COUPLING OF π AND A_1 TRAJECTORIES BY DUALITY. Auvil, P. R.; Halzen, F. (CERN, Geneva). Nucl. Phys.; B19: 29-41(1970).

Duality sum rules implied by the absence of resonances in the scattering of pseudoscalar-pseudoscalar, pseudoscalar-vector and vector-vector meson states in channels with exotic quantum numbers are studied. It is shown that the assumption of exact duality and SU(3) symmetry for the vertices leads inevitably to a decoupling of the π and the A_1 Regge trajectories. Next the view is taken that the experimental exchange degeneracy of the π and A_1 trajectories is not accidental and an alternative solution is proposed. It incorporates the normal degeneracy pattern for the leading vector and tensor trajectories but has a coupled triplet of exchange degenerate trajectories ($J^{PC} = 0^+$, 1^{++} and 1^+) at the secondary level. The implications of this solution for (i) meson spectroscopy, (ii) meson-meson-reggeon coupling and (iii) the breaking of duality are investigated. (auth)

52072 STRUCTURE OF THE $\pi\pi$ S- AND D-WAVES FROM ANALYTICITY, UNITARITY, AND CROSSING SYMMETRY IN THE NEUTRAL MODEL. Bonnier, B. (Institut de Physique Nucleaire, Paris). Nucl. Phys.; B17: 525-46(1970).

S- and D-waves are constructed in the neutral model from analyticity, unitarity and crossing symmetry. They are required to fulfill some rigorous constraints on the non-physical strip $0 \leq s \leq 4\mu^2$, including some recent complementary crossing conditions derived by Martin and Roskies. It appears that the S- and D-waves are practically determined by the S-wave scattering length a_0, $-0.5\mu^{-1} \lesssim a_0 \lesssim 0.15\mu^{-1}$. (auth)

52073 DIFFRACTIVE BACKGROUND TO THE VENEZIANO MODEL OF $\pi\pi$ SCATTERING. Brooker, P.; Taylor, J. C. (Oxford Univ.). Nucl. Phys.; B17: 467-71(1970).

A term which represents the exchange of a flat Pomeron, but which is otherwise as structureless as possible, is added to the Veneziano model amplitude for $\pi\pi$ scattering. The corrections in the small s, t, u-region are certainly greater than 7% and probably more like 50%. The correction to the Adler-Weisserger sum rule, however, is only of the order of 3%. (auth)

52074 CHIRAL LAGRANGIANS AND PCAC FOR THE η-MESON. Brooker, P.; Taylor, J. C. (Oxford Univ.). Nucl. Phys.; B17: 461-6(1970).

Two chiral Lagrangians with broken SU(3) × SU(3) symmetry are examined—a natural one which does not give PCAC for η-mesons, and a modified one which does. The possible use of the Veneziano model to choose between the two chiral theories is discussed. (auth)

52075 LEVEL STRUCTURE OF DUAL RESONANCE MODELS IN THE PRESENCE OF TWO TYPES OF TRAJECTORIES. Bishari, M.; Rittenberg, V. (Weizmann Inst. of Science, Rehovot, Israel). Nucl. Phys.; B19: 199-204(1970).

A dual resonance model for N pion-type particles (N even), with two different exchanged trajectories, is constructed. The model is explicitly shown to have factorization with a finite number of terms. The degeneracy of the levels is higher than that in the one-trajectory dual models. The degeneracy is higher due to two sources: the first is due to the fact that the external particles may not lie on the three-particle trajectory and the second is because of the different intercepts. (auth)

52076 WIDTH OF THE A_1 MESON FROM CURRENT ALGEBRA. Nasrallah, N. F. (Middle East Tech. Univ., Ankara). Nucl. Phys.; B19: 167-72(1970).

The $\pi\rho$ scattering amplitudes are studied using a method introduced by Fubini and Furlan. An expression is obtained for an off-mass-shell $A_1\rho\pi$ coupling constant. The physical A_1 width is then related to this off-shell coupling constant by saturating dispersion integrals with a 0^- tri-pion threshold enhancement (or resonance) conjectured by Pagels to explain the discrepancy between the experimental π-decay rate and the value obtained from the Goldberger-Treiman relation. $\Gamma_{A_1} = 75$ MeV is obtained. This method is also applicable to the calculation of the width of the $\Lambda^*(1405)$, the result is $\Gamma_{\Lambda^*} = 70$ MeV. (auth)

52077 GENERAL ANALYSIS OF THE VECTOR-MESON DOMINANCE MODEL PREDICTIONS FOR MESON DECAYS. Baracca, A. (Univ., Florence); Bramon, A. Nuovo Cim.; 69A: 613-31(21 Oct 1970).

Using the vector-meson dominance model, SU_3 symmetry and the ω-φ and η-X^0 mixing hypotheses (recent results seem to contradict the possibility of a mixing between the η and the E(1420)-meson) the decays of the pseudoscalar and the vector mesons are systematically investigated. The explicit expressions for phase-space evaluations are listed. The predictions of the model concerning the branching ratios and decay rates are discussed in detail, classifying those which are independent of some coupling constants, mixing angles and (or) experimental inputs. A consistent picture is obtained for the $\pi^0 \to \gamma\gamma$ and the $\omega \to \pi^0\gamma$ decay modes and the ω and φ branching ratios and a resonable agreement is generally found with the experimental situation, which is sometimes rather unclear. Our results seem to disagree with a recent determination of the branching ratios of the $\omega \to \eta\gamma$ and $\omega \to \pi^0\pi^0\gamma$ decay modes. (auth)

52078 INFINITE MULTIPLETS AND THE MESON SPECTRUM. Boehm, A. (Univ. of Texas, Austin). pp 81-95 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

The definition and discovery of infinite multiplets and the algebraic methods are described. Then the relativistic rotator model for meson and nucleon resonance masses is discussed, and the fine structure of the meson spectrum is treated. (J.F.P.)

52079 $\omega-\phi$ MIXING MODELS AND SOME APPLICATIONS. Gourdin, M. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). pp 117-32 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

The discussion of $\omega-\phi$ mixing models covers the mass formula, the pole model, mixing models, and the decay of vector mesons into two pseudoscalar mesons. (J.F.P.)

52080 O(4) GROUP EXPANSION OF SCATTERING AMPLITUDE AT NONEQUAL MASSES. Zamiralov, V. S.; Shepelev, G. I. (Moscow State Univ.). Yadern. Fiz.; 12: 197-8(Jul 1970). (In Russian).

A concept of an asymptotic O(4) little group is introduced with which one can write the O(4) expansion of the helicity amplitudes in the t channel at nonequal masses of the external particles. This expansion is used for determination of kinematic factors of helicity amplitudes of high energy forward scattering. (auth)

52081 DUALITY AND INTERNAL SPACE–TIME STRUCTURE OF HADRONS. I. BOSON SYSTEMS. Tanaka, Sho (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 44: 254-71(Jul 1970).

The Veneziano amplitude is analyzed as a consequence of a propagation of an extended object. The so-called duality is explained in this scheme to mean an equivalence between the propagation effects of the extended object through the direct channel and the crossed channel. The internal degrees of freedom and the interaction structure of the extended object required from the above duality are clarified. A single (4 + 2)-dimensional relativistic harmonic oscillator is needed as an internal degree of freedom. The interaction Hamiltonian of extended objects with such an internal structure is obtained, which leads us to the Veneziano amplitude of two-body reaction and enables one to get any amplitudes for higher order inelastic processes. The result is compared with the so-called generalized n-point dual amplitude, which is known to require for its dynamical derivation an infinite number of (5-dimensional) relativistic harmonic oscillators as internal degrees of freedom. (auth)

52082 UNITARITY IN DUAL MODELS. Collins, P. D. B.; Mir, K. L. (Univ. of Durham, Eng.). Nucl. Phys.; B19: 509-24(1970).

The problem of imposing unitarity in dual models is discussed. It is shown how one can use the Cheng–Sharp equations, with the Khuri representation of a Regge-pole amplitude, to impose unitarity on the Regge parameters, which are then used as input to a FESR. The potential due to the crossed-channel poles is supposed to be contained already, at least in an average sense, in the direct channel Regge poles due to the duality hypothesis. The model equations are solved for the exchange-degenerate ρf_0 trajectory in $\pi\pi$ scattering. It is found that the results of the narrow resonance approximation (NRA) are substantially unchanged by the unitarization, because there is an approximate cancellation of the unitarity corrections by the Khuri factor. Satisfaction of the FESR is possible for a range of |t| and N (the upper limit of integration in the FESR). This is taken to mean (a) that many of the conclusions drawn from NRA dual models are unlikely to be substantially modified by unitarity (at least for the leading trajectories in the low energy region), and (b) that unitarity does not determine the free parameters of the NRA model (the trajectory slope α' and coupling strength β) so that a proper bootstrap, in the old-fashioned sense, is not achieved. (auth)

52083 DUAL RESONANT AMPLITUDE FOR MANY PIONS. Panchapakesan, N. (International Centre for Theoretical Physics, Miramare, Italy). Lett. Nuovo Cim.; 4: 235-40(8 Aug 1970).

A possible modification of the Veneziano four-point amplitude is suggested for the inclusion of the ρ trajectories. The problem is to avoid the poles at zero values of the spin in channels with an even number of pions. Extra factors are included for this purpose. The six-pion amplitude and then the n-pion amplitude are given. The constructed amplitudes incorporate the ρ-f_0 and π-A_1 trajectories, have the correct Regge behavior, and are factorizable. (J.F.P.)

52084 POSITIVITY CONSTRAINTS ON CROSSING-SYMMETRIC PARTIAL-WAVE EXPANSIONS. Roskies, Ralph (Yale Univ., New Haven). Contract AT(30-1)-2726. J. Math. Phys. (N. Y.); 11: 2913-19(Sep 1970). (YALE-2726-562).

Based on positivity of the absorptive parts, constraints on the parameters appearing in Roskies' crossing-symmetric parametrization of the $\pi^0\pi^0$ partial waves below threshold are derived. These are then expressed as constraints involving integrals over the $\pi^0\pi^0$ s wave below threshold. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 51967, 52437, 52698, and 52699.

52085 (AD–705550) REMARKS ON THE CONNECTIONS BETWEEN THE HIGH-ENERGY BEHAVIOR OF RESONANCES AND UNITARITY. Paciello, M. L.; Sertorio, L.; Taglienti, B. (Rome Univ. (Italy). Istituto di Fisica). 22 Jul 1969. Contract F61052-67-C-0084. 29p. (NI–233; AFOSR–70-1235-TR). NTIS.

An attempt is made, with the aid of a model, to connect the existence of infinite resonances with increasing mass to the Regge asymptotic behavior, via inelastic unitarity. This process might be considered as a reggeization thereshold by threshold, with a simplified analytic structure which preserves crossing symmetry by sight. This last point is somewhat reminiscent of Veneziano. (auth)

52086 (AD–705553) COMMENTS ON OMEGA-LIKE REGGE POLE EXCHANGE IN K–N SCATTERING. Lusignoli, M.; Odorico, R.; Restignoli, M.; Violini, G. (Rome Univ. (Italy). Istituto di Fisica). 11 Jul 1969. Contract F61052-67-C-0084. 16p. (NI–232; AFOSR–70-1238-TR). NTIS.

It is shown that the evidence for the presence of a large omega absorptive correction in the B sup (-) amplitude at small values of t is affected by large uncertainties. (auth)

52087 DUAL-SYMMETRIC THEORY OF HADRONS. II. BARYONS. Frye, G.; Lee, C. W.; Susskind, L. (Yeshiva Univ., New York). Nuovo Cim.; 69A: 497-507(1 Oct 1970).

The theory of mesons is extended to include nucleons. The nucleon is described as a rubber band with three quarks located at symmetric positions. A prescription for obtaining dual meson–baryon amplitudes is derived. In the special case of the four-point nucleon–meson scattering we obtain B-functions for the s, t and u, t dual contributions. The s, u dual amplitude turns out not to be a B-function but rather a function first suggested by Mandelstam. The five-point functions are also explicitly constructed. The result is again similar to Mandelstam's function. An important observation is that diagrams are characterized by which baryon quarks are active in a given process. (auth)

52088 THE ANGULAR CORRELATIONS OF $\pi^\pm$ MESONS IN THE REACTIONS $\pi^\pm p \to \Lambda K m\pi$, AND $\pi^\pm p \to N\bar{K}Km\pi$ WITH $m \geq 3$ FOR ENERGIES OF 7.5 AND 8 GeV. Hulubei, Horia; Andreescu, Ileana; Besliu, Calin; Besliu, Tatiana; Gavrilas, Mariana; Mihul, Alexandru; Balea, Elena; Balea, Ovidiu; Sabau, Mircea (Univ., Bucharest). Compt. Rend., Ser. B; 271: 302-4(27 Jul 1970). (In French).

The data relative to the angular correlations $\pi\pi$ for the following strange particle reactions were presented: $\pi^\pm p \to \Lambda K m\pi$ ($m \geq 3$) and $\pi^\pm p \to N\bar{K}Km\pi$ ($m \geq 3$). Experimental values for the coefficients of asymmetry γ^{ij} were given; the existence of the Goldhaber effect was demonstrated for the second reaction only. (France)

52089 REMARKS ABOUT THE HYPOTHESIS OF LIMITING FRAGMENTATION. Chou, T. T.; Yang, C. N. (State Univ. of New York, Stony Brook). Contract AT(30-1)-3668B. Phys. Rev. Lett.; 25: 1072-5(12 Oct 1970).

Remarks are made about the hypothesis of limiting fragmentation. In particular, the concept of favored and disfavored fragment distribution is introduced. Also a sum rule is proved leading to a useful quantity called energy-fragmentation fraction. (auth)

52090 DUALITY CLASSES FOR PION–NUCLEON SCATTERING. Meggs, William J. (Univ. of Rochester, N. Y.); Gleeson, A. M. Nucl. Phys.; B19: 323-37(1970).

A modified form of duality is proposed. The dominant resonance towers in pion-nucleon scattering (the Δ_δ, N_α, and N_γ trajectories) are not dual to the dominant t-channel trajectories (the P, P′ and ρ) but are dual to a lower asymptotic contribution. Conversely, the P, P′ and ρ are assumed to be dual to the recently observed phase shift loops not associated with the dominant baryon trajectories. This proposed separation is tested by means of an interference-model calculation. In addition it is shown that the baryon trajectories have an asymptotic behavior of the form $s^{\alpha(t)}$ with $\alpha(o) \approx -0.5$. Implications of this conjecture are discussed. (auth)

52091 CROSSING-SYMMETRIC DESCRIPTION OF DATA WITH THE GENERALIZED VENEZIANO MODEL. Chan,

Hong-mo; Raito, R. O.; Thomas, G. H.; Tornqvist, N. A. (CERN, Geneva). Nucl. Phys.; B19: 173-98(1970).

The generalized Veneziano model is applied to study the reactions: $K^+p \to K^0\pi^+p$, $K^-p \to \bar{K}^0\pi^-p$, and $\pi^-p \to K^0K^-p$, which are related by crossing. It is found that with the same formula and essentially only one free parameter, one is able to give a good global description of all three reactions at energies ranging from 2.5 to 13 GeV. The possibility of extending the study to further reactions is also briefly considered. (auth)

52092 EXCHANGE DEGENERACY, ABSORPTION, AND LOOPS IN KN AND $\bar{K}N$ SCATTERING. Meyers, C.; Salin, Ph. (Faculte des Sciences, Bordeaux). Nucl. Phys.; B19: 237-58 (1970).

It is shown that exchange degeneracy is fully compatible with all present high-energy experimental data and even, in most cases, at surprisingly low energy. The implications of the necessary absorptive corrections are discussed. At the end loops for partial waves are obtained corresponding to a set of exchange degenerate Y_I^J all lying on a straight-line trajectory. (auth)

52093 COMMENT ON A CHEW–LOW EXTRAPOLATION TO DEDUCE S-WAVE $\pi\pi$ SCATTERING FROM STUDY OF THE REACTION $\pi^-p \to \pi^0\pi^0n$. Clegg, A. B. (Univ. of Lancaster, Eng.). Nucl. Phys.; B19: 160-6(1970).

It is shown that there is probably some considerable systematic uncertainty in the deduction of s-wave $\pi\pi$ scattering from a Chew–Low extrapolation in the reaction $\pi^-p \to \pi^0\pi^0n$, due to the fact that approximately 40% of the events in the peripheral peak at small momentum transfers are due to Δ^0 production. These events are shown to produce a peripheral peak very similar to that due to $\pi\pi$ scattering. The reaction mechanism for Δ^0 production is related to Δ-production in other charge states so as to: (i) provide support for the observation of Δ^0 production, (ii) give some indication of more detailed information that can be obtained about the mechanism of Δ-production from studies with better statistics, (iii) suggest care and caution in deducing $\pi\pi$ scattering information in other charge states, if backgrounds due to Δ-production are ignored. (auth)

52094 DISPERSION THEORY SUM RULES. Seth, V. P.; Sharma, M. C.; Agarwal, B. K. (Allahabad Univ., India). Nuovo Cim.; 69A: 569-72(21 Oct 1970).

Dispersion theory sum rules were studied for A and B $\pi\Xi$ amplitudes, for the linear combination of A amplitudes for πN and $\pi\Sigma$ scatterings, and for A and B amplitudes for the process $\bar{K}N \to K\Xi$. When the sum rules are saturated with the low-lying resonances they are found to be reasonably well satisfied. (auth)

52095 MAGNETIC MOMENTS AND STRONGLY BOUND CONSTANTS OF BARYON OCTET ($S = \frac{1}{2}^+$) AND DECUPLET ($S = \frac{3}{2}^+$). Bas'yuni, A.; Kurdgelaidze, D. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; No. 3, 115-18(May-Jun 1969). (In Russian).

Strongly bound constants and magnetic moments of baryons and quarks were determined and equations were obtained for magnetic moments of baryons and their resonances. Baryon magnetic moments were analyzed within the limits of the unitary theory (N. N. Bogolyubov) and Chiral theory (I. Schwinger). The Schwinger formulas for magnetic moments of baryon octets were resolved by developed formulas eliminating intrinsic magnetic moments of Dirac particles. Magnetic moments of quarks were examined by the Bogolyubov group. Considering that quark magnetic moments are too small the intrinsic magnetic moments of quarks were analyzed, mainly, by relativistic approximations within the limits of Schrödinger's equations with an effective potential. It was postulated that the method for studying quark magnetic moments within the aspects of field theory seemed more consistent. (R.V.J.)

52096 CROSSING $K^-p \to \pi^-\pi^+\Lambda$ INTO $\pi^+p \to K^+\pi^+\Lambda$ USING THE GENERALIZED VENEZIANO MODEL. Toernqvist, Nils A. (CERN, Geneva). Nucl. Phys.; B18: 530-6(1970).

The dual multiparticle model for $K^-p \to \pi^-\pi^+\Lambda$ suggested by Petersson and the present author is applied to the crossed reaction $\pi^+p \to K^+\pi^+\Lambda$. The complication due to Pomeron exchange is avoided by limiting ourselves mainly to the dominant subprocess $\pi^+p \to K^+Y^{*+}(1385)$. The model predicts correctly the energy dependence and differential cross sections and even the normalizing parameter within a factor of two. An alternative model suggested by the Harari–Rosner rules fails to give a good fit to the differential cross sections. (auth)

52097 MULTIPLE RESCATTERINGS IN MESON–NUCLEON AND NUCLEON–NUCLEON HIGH ENERGY COLLISIONS. Boreskov, K. G.; Ter-Martirosyan, K. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 12: 162-72(Jul 1970). (In Russian).

Formulas are obtained for πN, KN, NN, and $\bar{N}N$ elastic and charge exchange high energy scattering amplitudes with account of any number of rescatterings by arbitrary Regge poles. The formulas are reduced to a simple, fitted for numerical calculations form and are analogous to those for spinless particles. Assumption of exponential dependence of all the vertices on the momentum transfers squared was used to get the formulas. (auth)

52098 ELASTIC KN SCATTERING AND CHARGE EXCHANGE REACTIONS WITH ACCOUNT OF THE REGGE CUT CONTRIBUTION. Sukhorukov, S. T. Yadern. Fiz.; 12: 154-61(Jul 1970). (In Russian).

Experimental data on elastic $K^{\pm}N$ scattering and charge exchange reactions $K^-p \to \bar{K}^0n$, $K^+n \to K^0p$ are analyzed in the framework of the complex angular momenta method with account of the moving cuts. The cut contribution is parametrized in a simple form which corresponds to the optical model of rescattering. A reasonable agreement with the experiment in the region of small momentum transfers is obtained. (auth)

52099 NEW PERIPHERAL MODEL. Dar, A. (Deutsches Elektronen-Synchrotron, Hamburg. Technion-Israel Inst. of Tech., Haifa, India). pp 832-47 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A review is given of a peripheral model for exchange reactions in high-energy hadron interactions. The origin of the dips and spikes in the differential cross sections for these interactions is particularly discussed. A comparison is made with experimental values. (J.F.P.)

52100 REGGE-POLE MODEL OF K^+p SCATTERING. Carreras, B. (Daresbury Nuclear Physics Lab., Eng.); Donnachie, A. Nucl. Phys.; B19: 349-65(1970).

A Regge-pole parametrization for the K^+p scattering amplitude is given which describes almost all existing data above 0.70 GeV/c. The most acceptable fit to the data has a χ^2 of 1750 for 1005 degrees of freedom and gives reasonable predictions for K^+n and K^-p charge exchange at high energies. The low-energy projected partial waves differ from previous analyses in the sign of the real part of the s-wave amplitude, which is positive in this analysis. A comparison with the very low-energy data indicates that this possibility cannot be excluded. (auth)

52101 CURRENT-FIELD EQUAL-TIME COMMUTATORS AND HARD-PION TECHNIQUES. Weber, H. J. (Univ. of Virginia, Charlottesville). Lett. Nuovo Cim.; 4: 261-6(8 Aug 1970).

It is found that a proposed dynamical mechanism seems able to reconcile the geometrical structure of the vector-current-nucleon equal-time commutator with that of its axial analog so that hard-pion techniques for the πN system at rest are consistent with experiment, soft-pion, and ρ-dominance results. (J.F.P.)

52102 DERIVATION OF A VENEZIANO-TYPE REPRESENTATION FOR TWO-BODY PROCESSES INCLUDING BARYONS. Lacombe, M.; Nicolescu, B.; Vinh Mau, R. (Institut de Physique Nucleaire, Paris. Laboratoire de Physique Theorique et Hautes Energies, Paris). Nucl. Phys.; B19: 653-66(1970).

It is shown that, for the πN scattering case, the replacement of the usual partial wave expansion by an expansion in terms of Appell–Pochhammer polynomials can provide an unambiguous Veneziano type representation if some consistency relations between the dominant Regge trajectories are required. A possible interpretation of those relations, leading to a mass-quantization formula for hadrons, is discussed and compared with experiment. (auth)

52103 COMPARISON OF $\pi^{\pm}p$ AND K^-p REACTIONS WITH A MULTIPERIPHERAL MODEL USING THE VAN HOVE HEXAGON AND CUBOCTAHEDRON PLOTS. Bartsch, J. (Technische Hochschule, Aachen); Boesebeck, K.; Deutschmann, M.; (and others). Nucl. Phys.; B19: 381-98(1970).

Several reactions of 8 GeV/c π^+p, 10 GeV/c K^-p and 16 GeV/c π^-p are compared with the multiperipheral Regge-pole model of Chan, Łoskiewicz, and Allison, using the technique of longitudinal phase-space plots introduced by Van Hove, to investigate the relative importance of the various exchange diagrams. While the gross features of the data are satisfactorily reproduced at all energies, the detailed description meets with difficulties especially concerning pomeron-baryon (PB) exchange, for which contradictory results are obtained. For the reactions containing resonances in the final state, the following remarks can be made: a) when $\Delta^{++}(1236)$ is produced, the inclusion of PΔ exchange, not con-

sidered in the original model, improves the fits; b) while PB exchange is found to be dominant in the reactions of single-pion production, the reaction $\pi^-p \to p\pi^-\omega$ is better described if PB exchange is neglected. (auth)

52104 POLARIZATION OF Λ- AND Σ-HYPERONS IN TWO-BODY $Y_1^*(1385)$ PRODUCTION PROCESSES AND THE QUARK MODEL. Bialas, A. (Jagellonian Univ., Krakow. Inst. of Nuclear Physics, Krakow); Kotanski, A. Nucl. Phys.; B19: 667-72 (1970).

The two-body Y* production processes with $0^-\frac{3}{2}^+$, $1^-\frac{1}{2}^+$, and $\frac{1}{2}^+\frac{3}{2}^+$ final states are considered. The measurements of the polarization of Λ- and Σ-hyperons are discussed in the framework of the additive quark model. Several constraints are derived. The results provide strong and qualitatively new tests of the additivity assumption. In addition, a short summary of the experimental methods of determining the polarization moments of hyperons is given. (auth)

52105 K^- NUCLEAR INTERACTIONS AND YIELDS OF KAONIC X-RAYS. Ericson, T. E. O. (CERN, Geneva); Scheck, F. Nucl. Phys.; B19: 450-76(1970).

The K^- nuclear interaction in kaonic atoms is examined in light of recent presumed evidence for an anomalous neutron distribution in the nuclear surface. A K^- nuclear potential, proportional to the $\bar{K}N$ scattering lengths and nuclear density, reproduces observed X-ray yields within experimental uncertainty. With a nuclear matter distribution proportional to the known proton distribution, no additional freedom is needed at present. The variation of the capture width with radius and surface thickness parameters are discussed in detail. Estimates for energy shifts in the kaonic levels are given. Dynamical hyperfine and Stark mixing of kaonic orbits are discussed. Distortion effects of the K^- wave function by the strong interaction are important and may well dominate all other effects. The renormalization of the $\bar{K}N$ scattering lengths by multiple scattering in nuclear matter is estimated. Approximations and limitations of the model are discussed. (auth)

52106 COMMENTS ON THE REGGE-POLE MODEL FOR THE REACTION $KN \to K^*(890)N$. Dass, G. V. (Rutherford Lab., Chilton, Eng.); Froggatt, C. D. Nucl. Phys.; B19: 611-24(1970).

Difficulties of exchange models for the high-energy reaction $KN \to K^*(890)N$ are examined in the light of new data. The new experimental results allow an analysis of the reaction $K^+p \to K^{*+}p$ independent of low-energy data which strongly influenced our previous analysis. Although consistent with significant exchange amplitudes for the leading trajectories ω and P′ (but not P) at small $-t$, the fast energy dependence of the high-energy (4 to 13 GeV/c) $K^+p \to K^{*+}p$ data gives direct evidence for a very important secondary Regge contribution. This dominant low-lying isoscalar contribution remains a problem for the conventional exchange models and cannot be reproduced by a Reggeised absorption-cut model involving leading trajectories. Various models including secondary Regge poles previously used are constructed and the difficulties of some of these are pointed out. A typical Regge-pole model which can successfully reproduce the data on all charge modes is illustrated. This model has isoscalar contributions from the trajectories P′, a comparatively flat ω (without the cross-over zero) and a third vacuum Regge pole P′′ introduced in πN elastic scattering. (auth)

52107 SIMPLE MODEL FOR CHARGED VECTOR-MESON PRODUCTION. Mellema, D. J.; Henzi, R. (Univ. of California, Los Angeles). Nucl. Phys.; B19: 637-44(1970).

A simple model is proposed to account for the salient features of the reaction $\pi^+p \to \rho^+p$ and $K^+p \to K^{*+}(890)$ at high energies. It is argued that these processes are dominated by pion exchange and exchange-degenerate ω-f poles with SU(3) related residues. (auth)

52108 STUDY OF THE REACTION $K^-p \to p\bar{K}^0\pi^-$ WITH THE VENEZIANO MODEL. Bartsch, J. (Technische Hochschule, Aachen); Deutschmann, M.; Honecker, R.; (and others). Nucl. Phys.; B20: 63-76(1970).

The five-point function Veneziano model was applied to the reaction $K^-p \to p\bar{K}^0\pi^-$ in the energy range from ≈3 to 10 GeV/c. The predictions of the model are shown to be sensitive to the choices made for the assumptions and the parameters involved in the expression of the amplitude. Several choices can be made that give a satisfactory general description of this reaction. However, the mass spectra are not described in detail and the differential cross sections do not have the correct t-dependence, especially at the lower energies. These difficulties derive mostly from the fact that the simple model used does not consider the possibility that more than one trajectory is exchanged between a pair of particles. (auth)

52109 AMBIGUITIES IN THE EXPERIMENTAL DETERMINATION OF RESONANCE PRODUCTION AMPLITUDES. Gizbert-Studnicki, P. (Jagellonian Univ., Krakow); Golemo, A.; Zalewski, K. Acta Phys. Pol.; B1: 227-33(Jul-Sep 1970).

Experiments with unpolarized particles determine only partially the scattering amplitudes. For reactions $0^-\frac{1}{2}^+ \to 0^-\frac{3}{2}^+$ and $0^-\frac{1}{2}^+ \to 1^-\frac{3}{2}^+$ the most general transformation of the amplitudes is given, which leaves the experimental results unchanged. Implications for the quark model are also discussed. (auth)

52110 REGGE POLE MODEL WITH VENEZIANO RESIDUES FOR REACTIONS $0\text{-}\frac{1}{2}^+\ 0\text{-}\frac{3}{2}^+$. Gizbert-Studnicki, P. (Jagellonian Univ., Krakow); Golemo, A.; Zalewski, K. Acta Phys. Pol.; B1: 235-45(Jul-Sep 1970).

A Regge pole model for the reactions $\pi N \to \pi\Delta$, $\pi N \to \eta\Delta$ and $KN \to K\Delta$ is proposed. The description of the decay distributions and differential cross sections is good. The model contains six free parameters: the intercepts of the ρ and A_2 trajectories, a universal slope, the η, η′ mixing angle, and two coupling constants. The number of free parameters is kept low by the use of the quark model and of the Veneziano formula for the residues. The predictions for the differential cross sections of the π^+p processes at 16 GeV/c are also given. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 51944, 52406, and 52700.

52111 (JINR-E1-5219) COMPARISON OF NEW DATA ON p-p ELASTIC SCATTERING AT 15 TO 30 GeV/c WITH CALCULATIONS BASED ON THE MODEL OF THE DISCRETE VALUES OF $\langle p_\perp^2 \rangle^{1/2}$. Tolstov, K. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1970. 9p. Dep. CFSTI (U.S. Sales Only).

It is shown that the experimental data on elastic p-p scattering at 15, 20 and 30 GeV/c, obtained by E. Anderson et al. (PRL, 24, 689, 1970), agree well with the calculations based on the discrete values of root-mean-square transversal momenta: $\langle p_\perp^2 \rangle^{1/2} : \langle p_\perp^2 \rangle^{1/2} : \langle p_\perp^2 \rangle^{1/2} = 1 : 2 : 3$. (auth)

52112 (JINR-E2-5227) A TEST OF MODELS FOR THE ASYMPTOTIC BEHAVIOUR OF THE K^+p SCATTERING AMPLITUDES. Dumbrais, O. V.; Queen, N. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1970. 6p. Dep. CFSTI (U.S. Sales Only).

Many different models have recently been proposed to explain the Serpukhov data on the K^-p total cross section above 20 GeV, so that considerable ambiguity remains in the theoretical description of K^+p scattering at high energies. It is shown that a simple finite energy sum rule provides a strong consistency test of models for the asymptotic behavior of the amplitudes. In particular, the hypothesis that the K^+p total cross sections have already reached their asymptotic limits at 20 GeV can be ruled out by the sum rule. (auth)

52113 (NP-18446) THE ABSORPTION OF PIONS IN FLIGHT BY VERY LIGHT NUCLEI. Lazard-Martinet, Christiane (Paris Univ., Orsay (France). Faculte des Sciences). 1970. 75p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis.

The absorption of a pion by a deuteron $\pi^+ + d \rightleftharpoons p + p$ in the energy range of 0 to 300 MeV was studied. This reaction was described with the aid of the elementary pion nucleon interaction. The following conclusions were drawn: even for pions of practically zero energy, the direct absorption model by a single nucleon is insufficient, the two nucleons of the deuteron participate in the absorption of the pion. If the pions have energies in excess of 70 MeV, partial pion waves must be introduced, which are superior to p waves. The total and differential cross sections are critically dependent upon the form of the short distance nuclear wave functions. The absorption reactions of in flight pions by light nuclei were then studied, in particular He and ^{6}Li. The (π^+, 2p) reactions were important in obtaining information about the correlation of the two nucleons within the nuclei. From the deuteron absorption reaction, a model was developed for these reactions, in which preferential absorption by a pair of nucleons occurred and the pion two nucleons process $N + N \rightleftharpoons \pi + N + N$ was introduced and described phenomenologically with the aid of the appropriate differential cross sections. This model gives correct results but does not supply any information about the pair correlations in the target nucleus. A comparative study of the absorption reactions of a pion and the photoabsorption of a gamma ray photon at high energy (E_γ > 150 MeV) was made. (auth)

52114 (ORNL-tr-2373) INELASTIC INTERACTIONS OF HIGH-ENERGY PARTICLES WITH LIGHT NUCLEI. Abdinov,

O. B.; Barashenkov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated for Oak Ridge National Lab., Tenn., from report JINR-P2-5023. 11p. Dep. CFSTI.

The cascade-evaporation model of inelastic interactions of particles with nuclei is extended to light nuclei. Quantities characterizing the formation of clusters in the nucleus are established phenomenologically and subsequently determined by comparing the results of the calculations with experiment; only α-particle clusters are considered. The characteristics of elastic and inelastic interactions with α clusters are assumed to be the same as for interactions with free α particles, and the statistical theory of Fermi is used to calculate the probabilities of the various decay channels of the excited residual nuclei. Energy distributions, angular distributions, and cross sections are compared with the data. This cascade model can be used successfully to calculate the splitting of light nuclei by high-energy particles. (R.W.R.)

52115 DYNAMICAL CALCULATIONS IN THE THREE-BODY SYSTEM. Amado, R. D. (Univ. of Pennsylvania, Philadelphia). pp 243-64 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

It is pointed out that the success of dynamical calculations has been partly responsible for a new interest in the three-body problem, and the applications of such calculations are discussed. For a wide range of three-body processes, including both bound states and scattering, successful calculations have been made, and for most cases these are in substantial agreement with experiment. This calculational ability comes partly from the use of digital computers and partly from new theoretical foundations of the three-body problem, but mainly from new insights into how to handle the dynamics in a way more suitable to the three-body problem. Examples are given of the application of these new schemes, including the three-nucleon bound state, n-d scattering, break-up processes, d-α scattering, final state interaction effects in three-body decays, relativistic three-body calculation, $\bar{\Lambda}$-nucleon systems, etc. (16 references) (UK)

52116 NEUTRON-DEUTERON BREAKUP WITH AMADO'S MODEL. Cahill, R. T.; Sloan, I. H. (Univ. of New South Wales, Kensington, Australia). pp 265-74 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

The proton energy spectrum for the inelastic scattering of 14.4 MeV neutrons by deuterons was recalculated, using Amado's model, and somewhat different results were obtained from those reported previously. At laboratory angles >20° the differences were qualitatively insignificant, but for the two smaller angles, 4.8 and 10°, the differences were substantial. The neutron-neutron final state interaction peak was approximately doubled in magnitude at these angles, and the broader peak caused by neutron-proton final state interaction was increased in magnitude by about 25%. At both angles the agreement with experiment was improved, and at 10° the agreement was good. The calculations were performed with the method described previously, in which the integral equations are solved with complex momentum, and the three-body amplitudes with real final momentum k' then obtained by a further integration. For $k'^2 < mE$ the integration is straightforward, and the two calculations agree, from which agreement is inferred between the amplitudes on the complex contour. For higher final moments, including those relevant to the final state interaction regions, an additional integration around a cut is required, and here the calculations do not agree. The codes were checked in this region by using them to generate double scattering amplitudes, and comparing the results against double scattering amplitudes obtained by direct multidimensional integration. (10 references) (auth) (UK)

52117 SEPARABLE EXPANSION OF THE TWO-PARTICLE t-MATRIX AND THE THREE-NUCLEON PROBLEM. Kharchenko, V. F.; Petrov, N. M.; Storozhenko, S. A. (Inst. for Physics, Kiev). pp 301-18 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

The three-body problem for the case when the total energy of a three-nucleon system is negative is treated by means of separable expansions of the two-particle t-matrix. By expanding the wave function of the system in angular functions the Faddeev equations are reduced to an infinite system of bound homogeneous integral equations which can be cut short in the case of forces with a finite radius of action. The system of three identical spinless particles and that of three nucleons is considered. For the case of Hulthen's local potential the coupling energies of triton and neutron-deuteron scattering are calculated. (21 references) (auth) (UK)

52118 FINAL STATE INTERACTIONS BETWEEN THREE STRONGLY INTERACTING OUTGOING PARTICLES. Ebenhoeh, W.; Reiner, A. S. (Weizmann Inst. of Science, Rehovoth, Israel). pp 398-406 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

The original Migdal-Watson final state interaction therein relates amplitudes for deuteron photodisintegration and proton-neutron elastic scattering in corresponding angular momentum states. The theorem has often been applied to a pair of three outgoing particles. When focussing on the upper end of spectra of the observed particle, attempts have been made to isolate events where the undetected particles are in close contact, and assuming that the detected particle plays the role of a noninteracting spectator, it was hoped to extract from the relevant past of the spectrum information concerning the undetected pair. If the pair interaction is strong close to threshold a characteristic peak in the particle spectrum is obtained. Confusion with the Migdal-Watson peak yields estimates for parameters such as the scattering length (a) and the effective range (r) of the tested interaction. There are, however, at least two indications that throw doubt on the correctness of this procedure. The first relates to the observed break-up spectra for $n + d \rightarrow n + n + p$, yielding conflicting values for the n - n scattering lengths. Secondly, the calculated break-up spectra based on a preassured v_{nn} and known input a_{nn} showed a peak which would not be fitted by a MW spectrum with the same a_{nn}. Since there is ample evidence that separable forces are adequate inputs in the energy region considered, a failure of the MW theory is indicated. The Lovelace-Amado theory gives a model for three-particle reactions which is exact under the assumption of separable pair forces, and the application of this theory is explored, without actually solving the complicated basic equations. Quantitative conclusions are attempted by parameterising various components of the theory. Amongst matters considered are complementing Faddeev amplitudes, off-shell corrections, and spin effects. It is concluded that an Amado-type calculation which includes the discussed corrections is currently the only dependable way to extract n - n data from n + d break-up reactions. 6 references. (UK)

52119 SOLUTION OF N/D EQUATIONS FOR ELASTIC NUCLEON-DEUTERON SCATTERING. Avishai, Y.; Reiner, A. S.; Ebenhoeh, W. (Weizmann Inst. of Science, Rehovoth, Israel). pp 470-80 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

Three-particle contributions to unitarity were estimated from final state interactions and appeared as inelasticity corrections to elastic unitarity. The procedure was adequate for the decoupled $S = 3/2$ channels, in particular, if some off-shell corrections were applied. It failed for the pairs of coupled $S = 1/2$ channels, where left and right hand cuts overlapped, and single-channel Frye-Warnock equation with elasticities taken from experiment was considered. The driving terms for the equations are approximately represented by single and double nucleon exchange graphs. The anomalous size of the deuteron causes the single nucleon exchange force to have an unusually long range, and double nucleon exchange may therefore be important even for low energies and is indeed shown to be responsible for the observed excessive spin dependence of the scattering lengths. Numerical results comprised real and imaginary parts of the $\rho = 0$, 1, 2 phase shifts for $S = 1/2$ and $3/2$, differential cross sections and the triton binding energy. The agreement with experiment was good, in particular, for the $S = 3/2$ channels, but the results for the $S = 1/2$ channels were sensitive to the driving forces, off-shell corrections and inelasticities. The N/D approach was compared with potential theories. When separable interactions are used in the former to compute multiple nucleon exchange and inelasticities, there are striking similarities with the Faddeev-Lovelace-Amado theory. Equivalence could not be proved, but is conjectured to hold. 9 references. (auth) (UK)

52120 ONE-PION CONTRIBUTION TO NEUTRON-PROTON CHARGE-EXCHANGE SCATTERING. Londergan, J. T.; Thaler, R. M. (Case Western Reserve Univ., Cleveland). Phys. Rev. Lett.; 25: 1065-8(12 Oct 1970).

Recent measurements of neutron-proton charge-exchange scattering showed a change in the behavior of the cross section at u = 0, near the one-pion threshold. The slope of the backward cross section also increased rather rapidly, with a maximum also near the one-pion threshold. It is pointed out that the one-pion-exchange amplitude, interfering with a slowly varying amplitude at u = 0, gives qualitatively the same behavior as observed in the experiments. A similar explanation was suggested as an explanation for the n-p charge-exchange data above 2 GeV. (auth)

52121 EFFECT OF ΛΣ CONVERSION ON THE Λ-PARTICLE BINDING IN NUCLEAR MATTER. Nogami, Y.; Satoh, E. (McMaster Univ., Hamilton, Ont.). Nucl. Phys.; B19: 93-106 (1970).

The binding energy B of a Λ-particle in infinite nuclear matter is calculated in the so-called two-channel formalism (TCF), which explicitly takes account of the ΛΣ conversion, as well as in the more conventional one-channel formalism. In both calculations phenomenological separable potentials of Yamaguchi's type which permit exact solutions of the Bethe–Goldstone equation are assumed. All the potentials are assumed to be central and are set up so that the low-energy Λp scattering data are fitted. In the TCF, data on the elastic and inelastic Σ^-p cross sections are also considered. It is found that B in the TCF can be substantially smaller than in the OCF. The uncertainty in the result stems from the experimental data on the Σ^-p reaction, which is of crucial importance in determining the TCF potentials. The difference of the values of B in the two formalisms is due to the Pauli principle which suppresses the ΛΣ conversion in nuclear matter. The relation between this effect in the TCF and three-body ΛNN forces in the OCF is clarified. (auth)

52122 DUAL RESONANCE MODEL FOR HIGH-ENERGY DIFFRACTION DISSOCIATION. Pokorski, S.; Satz, H. (CERN, Geneva). Nucl. Phys.; B19: 113-24(1970).

Diffraction dissociation (Pomeron exchange) is combined with a dual resonance description for the dissociated system. The model is applied to single pion production in high-energy proton-proton collisions and shown to give quite good agreement with experimental data. (auth)

52123 ROLE OF COULOMB INTERACTION IN ELASTIC AND ALMOST ELASTIC SCATTERING OF HADRONS FROM NUCLEI. Czyz, W.; Lesniak, L.; Wolek, H. (Instytut Fizyki Jadrowej, Krakow). Nucl. Phys.; B19: 125-59(1970).

An analysis of the role of Coulomb interactions in the high-energy nuclear scattering processes without meson production is given. The high-energy scattering model of elastic and nuclear inelastic (sum-rules) scattering is tested on the available experimental material. Special attention is paid to the problem of extracting from the hadron-nucleus cross sections the real parts of the hadron-nucleon elastic scattering amplitudes. (auth)

52124 FINAL-STATE INTERACTION BETWEEN THE Λ^0 HYPERON AND ^3H IN THE $K^- + {}^4He \rightarrow \Lambda + {}^3H + \pi^0$ REACTION. Takahashi, Y. (McMaster Univ., Hamilton, Ont.); Mishima, N.; Ishizawa, R.; Iwamura, Y. Nucl. Phys.; B17: 472-6(1970).

An attempt is made to determine the low-energy parameters for the Λ^3H scattering by examining the final-state interaction in the reaction $K^- + {}^4He \rightarrow \pi^0 + \Lambda + {}^3H$ produced by stopped K^- mesons which was recently reported by Katz et al. For the singlet state we assume the scattering length and effective range to be a_s = 4.65 fm and r_s = 1.76 fm, respectively, which are in conformity with the binding energy of the ground state of ${}^4_\Lambda H$. Then, by using the Watson's final-state-interaction theory, a_t = 0.38 fm and r_t = 1.20 fm were obtained for the triplet state. This implies that there is no triplet bound (excited) state of ${}^4_\Lambda H$. (auth)

52125 HIGH-ENERGY DEUTERON–DEUTERON ELASTIC SCATTERING AND QUADRUPOLE DEFORMATION. Alberi, G. (Univ., Trieste, Italy); Bertocchi, L.; Bialkowski, G. Nucl. Phys.; B17: 621-33(1970).

The Glauber theory of high-energy deuteron-deuteron scattering, previously treated by Franco, is extended to include the D-state in the deuteron wave function. It is shown that the inclusion of the D-state does not completely fill the dip in the angular distribution due to the interference between single and double scattering. (auth)

52126 ESTIMATE OF Σ-SUPPRESSION IN HYPERNUCLEAR MATTER. Law, J. (Univ. of Guelph, Ont.). Nucl. Phys.; B17: 614-20(1970).

The correction to the well depth D_Λ of a Λ-particle in nuclear matter due to coupling to the Σ-channel is estimated directly from the available $\Sigma^-p \rightarrow \Lambda n$ cross section data. It is found that the contribution is about −6.8 MeV, with an accuracy of about 2.7 MeV. Combining this result with the estimate of Bhaduri and Law, a well depth $D_\Lambda = 51.0 \pm 15.7$ MeV is obtained. (auth)

52127 STRUCTURE OF NUCLEONS IN NUCLEAR MATTER. Nyman, Ebbe M. (Univ. of Helsinki. Stanford Univ., Calif.). Contract F44620-68-C-0075. Nucl. Phys.; B17: 599-613(1970).

Walecka has constructed a dynamical model for the motion of the pion field of a nucleon. This model was originally used to study the electromagnetic properties of the nucleon resonances. Essentially the same model is used to investigate how the field is modified when other nucleons are nearby, as in nuclear matter. The modified field leads to changes in the properties of the nucleons in nuclear matter. The connection with exchange currents is discussed. (auth)

52128 BINDING ENERGY OF A Λ-PARTICLE IN NUCLEAR MATTER: A COMPARISON OF TWO FORMULATIONS. Bishop, R. F. (Stanford Univ., Calif.). Contract F 44620-68-C-0075. Nucl. Phys.; B17: 573-98(1970).

Two approaches to the problem of calculating the binding energy B_Λ of a Λ-particle in nuclear matter are discussed. The first method is via the Bethe–Goldstone equation for the problem in the independent-pair approximation. The second method is a Green-function formulation which sums the ladder diagrams for the self-energy of the Λ-particle. Using an S-wave separable potential fitted to the ΛN scattering data, exact analytic expressions for B_Λ are found for both methods and compared. The relation between the two approaches is discussed and it is shown how to extend the Green-function formulation to include the effect of the higher-order cluster diagrams, contributing to the Λ-particle self-energy, in a consistent manner. It is pointed out that this approach provides a more systematic formulation than the usual extended Bethe–Goldstone approach. The model ΛN hard core problem is also investigated in the Green function approach in an appendix; the ground-state energy is rederived and expressions are found for the effective mass and damping of the Λ-quasi-particle up through terms of order $(k_F a)^2$. (auth)

52129 REGGE-POLE MODEL FOR ΛN INTERACTIONS. Kubis, J. J.; Walters, H. R. J (Cavendish Lab., Cambridge, Eng.). Nucl. Phys.; B17: 547-64(1970).

A Regge-pole model is constructed to predict high-energy ΛN scattering cross sections. It is based on an analysis of NN scattering which uses the trajectories P, P′ and ω. For forward ΛN scattering the same poles are used, while for backward scattering the poles $K^*(890)$ and $K_N(1420)$, whose trajectory parameters are extrapolated from ω and P′. The ΛN residues are related to NN residues by ratios of SU(3) coupling constants. The predictions for ΛN total cross sections, elastic cross sections, forward differential cross sections, and polarizations in the momentum range 5 to 16 GeV/c agree with the limited experimental data and are similar to the NN results. Backward ΛN cross sections are predicted to be much smaller than the forward ones, and our parametrization gives us rough agreement with data on the reaction $\bar{N}N \rightarrow \Lambda\Lambda$ at 3.0, 5.7 and 7 GeV/c. (auth)

52130 PION–DEUTERON ELASTIC SCATTERING AND BAKAMJIAN–THOMAS TRANSFORMATION THEORY. Johnson, D. E.; Leacock, R. A. (Ames Lab., Iowa). Nuovo Cim.; 69A: 573-84(21 Oct 1970).

It is shown, using the transformation theory of Bakamjian and Thomas, how to introduce potentials into the pion-deuteron elastic-scattering problem without destroying Poincaré invariance. Thus the usual difficulties of using potentials in relativistic situations are avoided. A direct numerical comparison of the Bakamjian–Thomas center-of-momentum formulation and a similar Breit-frame analysis is made for πd and pd elastic scattering. Quantitative differences are found in the double-scattering amplitudes in the two formulations. (auth)

52131 DETERMINATION OF THE NΛK COUPLING CONSTANT WEAKLY DEPENDENT ON THE UNPHYSICAL-REGION PARAMETRIZATION. Restignoli, M.; Violini, G. (Univ., Rome). Contract F 61 05267 C 0084. Nuovo Cim.; 69A: 691-701(21 Oct 1970).

Using a dispersion relation for a function related to the $K \pm N$ scattering amplitude it is possible to make the value of the NΛK coupling constant depend weakly on the parametrization used for the $\bar{K}N$ unphysical region. The numerical application of the method confirms the violation of the SU_3 symmetry for the NYK coupling constants. (auth)

52132 MODEL FOR THE HIGH-ENERGY pp AND $\bar{p}p$ DIFFRACTION SCATTERING. Antoniou, N. G.; Georgalas, C. G.; Kouris, C. B. (Democritos Nuclear Research Center, Athens). Z. Phys.; 238: 312-20(1970).

The high energy elastic pp and $\bar{p}p$ scattering is studied within the framework of a specific model for the diffractive background.

The double Pomeron exchange as well as secondary trajectory contributions are properly taken into account. The total cross section, the phase of the forward amplitude and the angular distribution are computed and compared with the existing experimental data. (auth)

52133 SUM RULES FOR NUCLEON–NUCLEON SCATTERING. Grigor'yants, A. G.; Fil'kov, L. V. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 12: 139-53(Jul 1970). (In Russian).

Integral relations are obtained between imaginary parts of the NN-scattering amplitude in s, u, and t channels. These relations are used to determine the meson–nucleon coupling constants for mesons contributing to the intermediate states of NN scattering. (auth)

52134 THEORY OF HIGH ENERGY HADRON-NUCLEUS COLLISIONS. Glauber, R. J. (Harvard Univ., Cambridge, Mass.). pp 207-64 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Diffraction theory for high-energy hadron–nuclei collisions is studied. This study is confined to elastic hadron–nuclei collisions and to collisions which are inelastic in the purely nuclear sense. The discussion covers nuclear diffraction theory, elastic scattering measurements, elastic scattering by heavier nuclei, the inelastic component of summed scattering, and charge exchange and particle production processes. (J.F.P.)

52135 MEDIUM ENERGY NUCLEON INTERACTIONS WITH NUCLEI. Gugelot, P. C. (Univ. of Virginia, Charlottesville). pp 265-77 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Some representative cases are described in the review of medium-energy nucleon reactions with nuclei. Both elastic and inelastic scattering are disucssed. (J.F.P.)

52136 EFFECT OF THE DEUTERON'S D-WAVE COMPONENT IN HIGH-ENERGY SCATTERING. Harrington, David R. (Rutgers–The State Univ., New Brunswick, N. J.). pp 310-14 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A review of the effect of the deuteron D-wave component in high energy scattering is given. This review is theoretical and covers the discovery of the electric quadrupole moment of the deuteron through to the Glauber approximation and break region phenomena. (J.F.P.)

52137 INVESTIGATION OF THE NUCLEON–DEUTERON SYSTEM. Remler, Edward A. (Coll. of William and Mary, Williamsburg, Va.). pp 324-5 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Nucleon–deuteron elastic scattering in the forward hemisphere is discussed. The results seem very tentatively to indicate that the s-state implied by the data shows greater probability of small nucleon separation than is exhibited by the Hamada–Johnson wave function. (J.F.P.)

52138 SEPARABLE APPROXIMATION FOR N–D SCATTERING. Harms, E.; Laroze, L.; Levinger, J. S. (Rensselaer Polytechnic Inst., Troy, N. Y.). pp 329-31 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Improvements to the Adado calculation of neutron–deuteron scattering by a spin-dependent central potential with the Yamaguchi form factor are presented. The unitary pole approximation form factor for a realistic potential with a soft core is used, and tensor forces are included. (J.F.P.)

52139 MODEL FOR INELASTIC EFFECTS IN HIGH-ENERGY PION–DEUTERON SCATTERING. Harrington, David R. (Rutgers–The State Univ., New Brunswick, N. J.). pp 446-8 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A highly idealized yet simple and internally consistent model is constructed for inelastic state corrections in pion–deuteron scattering. In this model the pion is treated as the ground state of a system of two constituents having nonrelativistic internal motions. Pion–deuteron scattering at high energies is treated as a slightly generalized version of deuteron–deuteron scattering using the Glauber model. (J.F.P.)

52140 PHENOMENOLOGICAL INVESTIGATIONS OF CHARGE SYMMETRY BREAKING IN THE Λ–N INTERACTION. Hartt, K.; Sullivan, E. (Univ. of Rhode Island, Kingston). pp 777-9 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The strength and spin dependence required of the charge-symmetry-breaking S-wave interaction, to explain low-energy Λ + p elastic scattering cross sections at c.m. energies below 18 MeV, are calculated. (J.F.P.)

52141 OPTICAL POTENTIAL FOR HIGH ENERGY PION–NUCLEUS AND NUCLEON–NUCLEUS SCATTERING. Kembhavi, V. K.; Jackson, Daphne F. (Univ. of Surrey, Guildford, Eng.). pp 850-1 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The optical potentials for pion–nucleus and nucleon–nucleus scattering in the GeV region are studied using a matter distribution constructed from single-particle wave functions which fit electron scattering and also a Fermi distribution. Results show that the difference between the potentials is greater for the single-particle than for the Fermi distribution. The difference is shown to be not negligible even for calcium-40. (J.F.P.)

52142 COMPATIBILITY BETWEEN DIFFRACTIVE AND STATISTICAL MECHANISMS. Predazzi, E. (Univ., Turin, Indiana Univ., Bloomington). pp 852-4 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A sum of Gaussians for small-angle p + p elastic scattering, called a diffractive expansion and a sum of exponentials for large-angle p + p elastic scattering, called a statistical expansion are compared and related. (J.F.P.)

52143 ANALYSIS OF DOUBLE CHARGE EXCHANGE OF PIONS OF ^{4}He. Becker, F. (CRN, Strasbourg); Schmit, C. Nucl. Phys.; B18: 607-24(1970).

The double charge exchange of π^- mesons on ^{4}He is analyzed in the framework of a model which assumes that the process takes place on a pair of nucleons of the target. The double differential cross section $d^2\sigma/dEd\Omega$, the differential cross section $d\sigma/d\Omega$ and the total cross section σ for this process are calculated and compared with the available experimental data, the behavior of which is generally explained. The shape of the wave functions is discussed and some conclusions are drawn on the relative influence of the 3,3 πN resonance and of the S_0NN resonance on the results. In the comparison between all the available experimental data, some discrepancies are observed and discussed. (auth)

52144 HIGH-ENERGY PROTON–PROTON SCATTERING AND AN EXTENDED-PARTICLE MODEL. Ueda, Tamotsu (Osaka Univ.). Progr. Theor. Phys. (Kyoto); 44: 183-92(Jul 1970).

A bilocal-field-exchange model is studied for proton–proton scattering at high energy. A bilocal field is shown whose nonlocality effect removes a difficulty of diverging property of the one-boson-exchange amplitude. (auth)

52145 RELATION CONNECTING ELASTIC PROTON–PROTON AND ELECTRON–PROTON SCATTERING BY MEANS OF A BREMSSTRAHLUNG MODEL. Gemmel, H. (Univ., Munich). Lett. Nuovo Cim.; 4: 697-702(10 Oct 1970).

It is shown that a previously discussed relation between the differential cross section for elastic p + p scattering at high energies and large momentum transfers and the proton electromagnetic form factors follows in a natural way from a relativistically invariant version of a previously discussed bremsstrahlung model. Also a generalization of this relation is given which is in good agreement with experiments. (J.F.P.)

52146 SOME ASPECTS OF THE EIKONAL APPROXIMATION IN HIGH-ENERGY NUCLEON–NUCLEON SCATTERING. Geicke, J. (Freie Univ., Berlin). Nucl. Phys.; B19: 399-412(1970).

An eikonal model for high-energy nucleon–nucleon elastic and charge-exchange scattering is presented. To describe spin effects completely the partial wave decomposition of the helicity amplitudes is first considered. No ambiguities are caused by the existence of two (mostly used) sets of partial-wave amplitudes. The analytic structure in the complex-angular-momentum plane is considered. Finally, by means of an isospin decomposition with regard to the s- and t-channel it is shown how the eikonal model may be applied to charge-exchange processes. The model seems to apply also to two-particle scattering with higher spins. (auth)

52147 PHENOMENOLOGICAL CROSS SECTIONS FOR THE REACTION $\pi^+d \rightarrow ppy$. Picciotto, Charles.; Smith, Donald (Univ. of Victoria, B. C.). Nucl. Phys.; B19: 366-72(1970).

A phenomenological calculation of the cross sections for the reaction $\pi^+d \rightarrow ppy$ is presented based on the available experimental data for the reaction $\pi^+d \rightarrow pp$. The pion lab energy range considered is 150 to 300 MeV. The geometry is chosen such that the two proton angles are equal, and results are given for various values of that angle. (auth)

52148 EFFECTIVE-RANGE THEORY AND THE NAMBU–SALPETER–BETHE EQUATION. Tanaka, Fujio (Nara Tech. Coll., Yamato, Japan). Nara Kogyo Koto Senmon Gakko Kenkyu Kiyo; No. 5, 89-92(Mar 1970).

In order to obtain the low energy scattering parameters (the scattering length and the effective range), the Nambu–Salpeter–Bethe equation is solved numerically for the $^1S_0$ state of the nucleon–nucleon scattering. The negative-energy contributions are neglected. Three types of renormalizable meson–nucleon interactions are assumed, that is, pion-, neutral-vector-meson-, and scalar-meson-exchange. If one takes suitable values of the meson masses and the meson–nucleon coupling constants, the calculated values of the low-energy scattering parameters fit the experimental ones. (auth) (Japan)

52149 TWO-NUCLEON ABSORPTION RATE IN K^- MESIC ATOMS. Aslam, K.; Rook, J. R. (Nuclear Physics Lab., Oxford). Nucl. Phys.; B20: 159-72(1970).

A recent calculation by Wycech has reproduced the experimental data on the relative two-nucleon absorption rates for K^- mesic atoms of deuterium and heavy nuclei despite conclusions to the contrary from earlier calculations and qualitative arguments. These earlier calculations and arguments are compared with the more recent one and it is shown where the differences arise. It is concluded that even the latter calculations contain doubtful approximations but that the conclusions obtained there are correct. Thus any discrepancy between theory and experiment is not of the order of twenty as previously supposed but rather an order of magnitude less than this figure and in consequence there is no evidence for alpha-particle clusters in the nuclear surface as proposed by Wilkinson. (auth)

52150 RELATIVISTIC TRIANGLE-DIAGRAM CROSS SECTIONS AND THE $pn\pi$ SYSTEM. Baldo, Marcello; Recami, Erasmo (Univ., Catania, Italy). Nucl. Phys.; B19: 525-45(1970).

The total cross section is evaluated explicitly for relativistic processes, with three final particles, proceeding through triangle diagrams. The aim is to give evidence for possible anomalous behavior, in some cross sections, produced purely by kinematics. It is suggested that the final-state interactions considered may contribute in explaining (partially, at least) some enhancements in the effective-mass distributions as due to kinematical (non-dynamical) effects. The general formulas are for example applied to the $pn\pi^+$ system, and seem to allow reproducing the known peaking in the $d\pi^+$ distribution at about 2.2 GeV/c^2; the model, in particular, could give a possible justification for the appreciable deuteron survival in some collisions of mesons and deuterons, even at high projectile energies. The triangle-graph peaks appear to be highly asymmetric. Applications to nuclear physics are also considered; and a very simple formula—valid in this field—is given to predict the position of possible kinematical peaks. (auth)

52151 EQUATION OF STATE FOR DENSE NEUTRON MATTER. Banerjee, B.; Chitre, S. M.; Garde, V. K. (Tata Inst. of Fundamental Research, Bombay). Phys. Rev. Lett.; 25: 1125-8(19 Oct 1970).

A solid-body model for neutron matter is proposed for calculating the equation of state for densities beyond the nuclear density using the Reid soft-core potential for the neutron–neutron interaction. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 52080, 52178, 52199, 52207, and 52696.

52152 (KFKI–70-16-HEP) SL(2,C) REPRESENTATIONS IN EXPLICITLY ENERGY DEPENDENT BASIS. Szego, K.; Toth, K. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). [1970]. 17p. Dep. CFSTI (U. S. Sales Only).

Unitary and nonunitary representations of the SL(2,C) group are investigated in such a basis, in which the subgroup diagonalized is that one, which in the four-dimensional representation leaves invariant the four-vector $p_\mu = [(1 + v/2)0, 0, (1 - v/2)]$ for arbitrary real value of $p_\mu^2 = v$. The split of the representation space into irreducible subspaces changes smoothly when varying the value of v. The formalism is of importance in physical theories which postulate analyticity requirements and Lorentz invariance simultaneously/e.g. Regge and Lorentz pole theory/. Explicit basis functions of the representation spaces are constructed. (auth)

52153 SPONTANEOUS BREAKDOWN OF DISCRETE INTERNAL SYMMETRIES. Sen, R. N. (Technion–Israel Inst. of Tech., Haifa, Israel). Nucl. Phys.; B17: 489-92(1970).

It is proved that the spontaneous breakdown of discrete internal symmetries entails the existence of massless fields, provided the asymptotic completeness condition holds when the smallest mass in the theory is finite. The result is valid for relativistic as well as non-relativistic theories. The notion of a discrete internal symmetry is defined algebraically, by abstraction from the "normal" solution in which all symmetry operations are unitarily implementable. (auth)

52154 CURRENT COMMUTATION RELATIONS, CONTINUOUS TENSOR PRODUCTS, AND INFINITELY DIVISIBLE GROUP REPRESENTATIONS. Streater, R. (Imperial Coll. of Science and Tech., London). Rend. Scu. Int. Fis. Enrico Fermi; 45: 247-63(1969).

A definition of the tensor product of a countable set of Hilbert spaces, $\{H_i\}_{i\in N}$, was given by Von Neumann. The analog is given for the case where i runs over a continuous index. The "incomplete" tensor product is generalized. (L.B.S.)

52155 REMARKS ON SPIN DEPENDENCE OF ANNIHILATION CROSS SECTIONS $p\bar{p} \rightarrow K^+K^-$, $K^0\bar{K}^0$, $\pi^+\pi^-$. Lyuboshits, V. L. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 12: 199-201(Jul 1970). (In Russian).

Some universal relations which characterize the spin dependence of the total and "forward-backward" differential cross sections for the annihilation processes $\bar{p}p \rightarrow K^+K^-$, $K^0\bar{K}^0$, $\pi^+\pi^-$, are discussed in framework of CP invariance. (auth)

52156 SIMPLE METHOD FOR THE EXPLICIT CALCULATION OF d-FUNCTIONS. Wolters, G. F. (Univ. of Amsterdam). Nucl. Phys.; B18: 625-53(1970).

The present status concerning techniques for computing explicit expressions for d-functions is briefly reviewed. A simple and economical new computational procedure is proposed, and results obtained by this method are presented. They pertain to the matrix elements $d^j_{m,m'}(\theta)$ for all integer and half-integer values of j less than or equal to ten. Also closed explicit expressions, generally valid in j and m for $j-m'$ less than or equal to ten, are given. (auth)

52157 REPRESENTATIONS OF THE TOTAL INHOMOGENEOUS DE SITTER GROUP AND THE EQUATIONS IN THE FIVE-DIMENSIONAL APPROACH. I. Fushchich, V. I. (Inst. of Mathematics, Kiev). Teor. Mat. Fiz.; 4: 360-82(Sep 1970). (In Russian).

A study was made of the irreducible representations of the total inhomogeneous de Sitter group $\tilde{\mathcal{P}}(1,4)$. The canonical and noncanonical equations of motion invariant under the $\tilde{\mathcal{P}}(1,4)$ group are found. The equation is proposed which makes it possible to obtain the mass spectrum of the particles increasing with spin and isospin, and, as a by-product, the equation of motion for zero-mass particle is obtained, which is the covariant generalization of the Weyl–Hammer–Good equation. The eight-component equation is shown to be the simplest P-, C- and T-invariant equation in the five-dimensional approach. Canonical transformations for the free equations of the Dyrac type are considered. (auth)

52158 ALGEBRAIC REALISATIONS OF CHIRAL SU(3) × SU(3) SYMMETRY. Sudbery, A. (Univ. of Glasgow). Nucl. Phys.; B20: 1-13(1970).

Weinberg's algebraic treatment of chiral symmetry is applied to chiral SU(3) × SU(3). The meson mass spectrum is obtained for the limit of exact symmetry; a simplistic approach to symmetry breaking yields fairly good results. If certain natural conditions are imposed, there is no Lie algebra containing the axial coupling matrices at arbitrary helicity. (auth)

52159 CHARACTERS OF THE POINCARE GROUP. Fuchs, Gerard; Renouard, Pierre (Ecole Polytechnique, Paris). J. Math. Phys. (N. Y.); 11: 2617-45(Sep 1970).

The characters of the Poincaré group $\bar{P}$ as solutions of differential equations are calculated in a way which is valid for a large class of Lie groups. The solutions of linear differential equations on an analytic manifold in a space of distribution are discussed. Then the characters of SL(2,R) and the central distributions on $\bar{P}$ are calculated. Finally the characters of all unitary irreducible representations of $\bar{P}$, including mass 0, and some expressions which may be "characters" of nonunitary representations are given. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 51891, 52448, 52501, 52606, and 52608.

52160 (AD-705552) WEAK INTERACTION AND THE BREAKING OF HADRON SYMMETRIES. Cabibbo, N.; Maiani, L. (Rome Univ. (Italy). Istituto di Fisica). 20 Jan 1970. Contract F61052-67-C-0084. 57p. (NI-251; AFOSR-70-1237-TR). NTIS.

Recently a dynamical relation among weak, strong and electromagnetic interactions was proposed on the basis of a self-consistency condition which requires that the description of hadron physics remains unchanged by the effect of leading weak corrections and electromagnetic tadpole effects. The main results of the approach were a relation between the weak interaction angle (theta) and the symmetry breaking parameters, and the appearance of a nonelectromagnetic breaking of isotopic spin. A review of the whole theory is presented putting a particular emphasis on those aspects which do not require explicitly the use of the self-consistency condition. (auth)

52161 TEST OF TIME-REVERSAL INVARIANCE IN ELECTROMAGNETIC INTERACTIONS. Mo, L. W. (Stanford Linear Accelerator Center, Calif.). pp 739-41 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

An experiment to test time reversal invariance in electromagnetic inelastic interactions of electrons and positrons with protons at 12 to 18 GeV is described. No T violation was found, and only a small two-photon exchange effect was observed in the (33) resonance region. (J.F.P.)

52162 PHENOMENOLOGICAL ANALYSIS OF NEUTRAL K-MESON DECAY. Ito, Yukio (Fukushima Univ., Japan). Progr. Theor. Phys. (Kyoto); 44: 284-5(Jul 1970).

Neutral kaon semi-leptonic decay is studied. The decay rates and the time distributions of leptons are written as functions of s, t, and u in order to derive the method for finding the magnitudes of these CP-violating parameters. (J.F.P.)

Applications (Strong)

Refer also to abstract 52695.

52163 (AD-705551) SU(3) x SU(3) BREAKING AND THE MESON SYSTEM. Mohanti, A. K. (Rome Univ. (Italy). Istituto di Fisica). 10 Jun 1970. Contract F61052-67-C-0084. 19p. (NI-223; AFOSR-70-1236-TR). NTIS.

A chiral Lagrangian model of spin-0 and -1 mesons transforming linearly under SU (3) × SU (3) broken in a way to preserve field-current identity, SU (3) invariance of Schwinger terms, and PCAC at SU (2) level is discussed, and $F_K/(F_\pi)$ $(f_{+(0)})$ is determined with reasonable agreement with experiment. (auth)

52164 (PTB-36) FURTHER EVIDENCES FOR EXCHANGE DEGENERACY WITH SU_3 SYMMETRY AND ABSORPTIVE CORRECTIONS IN HYPERCHARGE EXCHANGE REACTIONS. Meyers, C.; Noirot, Y.; Rimpault, M.; Salin, Ph. (Bordeaux Univ. (France). Laboratoire de Physique Theorique). Jul 1970. 31p. Dep. CFSTI (U. S. Sales Only).

All hypercharge and charge exchange reactions for meson-baryon scattering $(0^- \tfrac{1}{2}^+ \rightarrow 0^- \tfrac{1}{2}^+)$ were analyzed with exchange degeneracy, SU_3 symmetry, and absorptive corrections. Good agreement for polarizations and differential cross sections including the line reversed reactions $K^-p \rightarrow \pi^-\Sigma^+$ and $\pi^+p \rightarrow K^+\Sigma^+$ was obtained in terms of essentially one single parameter. (France)

52165 T-INVARIANCE CHECK IN 635 MeV ELASTIC PROTON-PROTON SCATTERING. Zulkarneev, R. Ya.; Nadezhdin, V. S.; Satarov, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 771-3 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

In order to check the polarization asymmetry from T-invariance in proton-proton elastic scattering, the polarization was determined in the triple proton scattering on parallel planes. It is found that if there is any effect of T invariance violation in the angle and energy regions studied, it occurs at a level below (2 to 3)$(10)^{-2}$ of the total amplitude of elastic pp scattering. (J.F.P.)

52166 SYMMETRIES AND QUARK MODELS. Proceedings of the International Conference held at Detroit, Michigan, June 18-20, 1969. Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970). 416p. $27.50. (CONF-690607).

The conference included 22 papers three of which were abstracted previously in NSA. For abstracts of these papers see abstract numbers: 23: 32649, 23: 34574, and 23: 44630. Separate abstracts were prepared for 19 papers. (J.F.P.)

For abstracts of individual papers see: 51868, 51877, 51941, 51991, 51992, 52049, 52060-52065, 52078, 52079, and 52167-52171.

52167 REPRESENTATIONS OF THE ALGEBRA OF INTEGRATED CONTRACTED CURRENT COMMUTATORS. Michel, Louis (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France); Ne'eman, Yuval. pp 15-27 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

The use of the commutation relations of "field algebra" implies relinquishing the proposed identification of the SU(6) algebra [and SU(6)w] with space integrals of current components. The latter now form an inhomogeneous algebra, whose representations are studied in order to check whether they might still display a similarity to the SU(6) classification of the spectrum. The results are negative. (auth)

52168 EXCHANGE DEGENERACY AND SU(3). Capps, Richard H. (Purdue Univ., Lafayette, Ind.). pp 39-47 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

The exchange degeneracy hypothesis which is discussed requires that in hadron-hadron scattering amplitudes of exotic internal quantum numbers (quantum numbers for which no resonances occur) the sum of the imaginary parts of the Regge pole contributions corresponding to particles in either crossed channel must vanish. If the observed hadrons are classified by one of the symmetry groups SU(n) then the only nonexotic hadron states are the quark-antiquark representation states of baryon number zero and the three-quark states of baryon number one. In SU(3) these are singlet and octet mesons and singlet, octet, and decuplet baryons. Exact SU(3) symmetry is assumed in the discussion. (J.F.P.)

52169 SYMMETRY-BREAKING MECHANISM IN STRONG INTERACTIONS. Gupta, Suraj N. (Wayne State Univ., Detroit). pp 51-8 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

It is determined whether one can construct a model of strong interaction symmetries which has resemblance with the quark model but does not require the existence of physical quarks. The results obtained by means of the symmetry-breaking formalism are presented. These results concern mass formulas and mixing angles of hadrons. (J.F.P.)

52170 APPLICATIONS OF CHIRAL CURRENT ALGEBRA. Arnowitt, R. (Northeastern Univ., Boston). pp 147-62 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

Some applications of the hard-meson chiral current algebra techniques to boson systems are briefly summarized. The nature of chiral breakdown and SU(3) breakdown in this analysis is emphasized. The $\pi-\pi$ system, the forms of SU(2) × SU(2), PCAC hypothesis, and SU(3) × SU(3) breakdowns are discussed. (J.F.P.)

52171 HOW GOOD ARE SYMMETRY PREDICTIONS? Meshkov, Sydney (National Bureau of Standards, Washington, D. C.). pp 199-212 of Symmetries and Quark Models. /Chand, Ramesh (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From International Conference on Symmetries and Quark Models, Detroit, Mich. See CONF-690607.

The validity of $SU(6)_W$ meson–baryon reaction predictions is considered, and an attempt is made to understand the apparently tremendous breakings of the symmetry for four-point functions. It is found that the symmetry is broken in a rather regular, though not understood, way which nevertheless allows one to make quantitative predictions for forward and possibly backward meson–baryon reaction cross sections at high and low energies. It is found how to obtain useful results out of the $SU(6)_W$ reaction predictions by taking ratios for processes whose strangeness exchange properties are similar and whose final-state masses are not too different. (J.F.P.)

52172 UNITARY IRREDUCIBLE REPRESENTATIONS OF $SL(n,C) \cdot R(n^2)$. I. Angelopoulos, E. (Institut Henri Poincare, Paris). J. Math. Phys. (N. Y.); 11: 2883-97(Sep 1970).

The family of Lie groups $SL(n,C) \cdot R(n^2)$ is studied from the mathematical point of view, i.e., their structure and unitary irreducible representations. The first steps in the study of representations are based on the Wigner–Mackey–Bruhat method. The homogeneous spaces and little groups are determined by introducing a (generally) pseudo-Hermitian metric on vector spaces of finite dimension. However, the presence of null vectors does not allow this approach to be an exhaustive one; there are cases where the stabilizer is a semidirect product of a reductive group by a nilpotent one. In such cases, results are available if the reductive subgroup is compact, but it seems that these results can be generalized. The connection is also examined, both in structure and in representations, between this family and creation–annihilation operators. A complete list of inequivalent classes of representations is given in terms of orbits and little groups for $n = 2, 3, 4, 6$. (auth)

Field Theories

General

52173 HERMITIAN SYMMETRY IN EINSTEIN'S UNIFIED FIELD THEORY. Klotz, A. H. (Univ. of Sydney). Acta Phys. Pol.; B1: 261-70(Jul-Sep 1970).

The result of hermitian symmetry in Einstein's unified field theory is examined in terms of the pseudo-tensor $U^{\gamma}_{\mu\nu}$ for which the Ricci tensor is hermitian symmetric. Einstein's expression for $U^{\Delta}_{\mu\nu}$ is shown not to be unique. It is also shown that there is no linear expression for the affine connection in terms of such a pseudo-tensor which would lead to invariant symmetry conditions. (auth)

52174 EXACTLY SOLVABLE ELECTRODYNAMIC TWO-BODY PROBLEM. Rudd, R. A.; Hill, Robert Nyden (Univ. of Delaware, Newark). J. Math. Phys. (N. Y.); 11: 2704-13(Sep 1970).

The equations of motion of the physical 2-body problems of relativistic electrodynamics are differential–difference equations. However, in the unphysical 2-body problem in which one particle responds only to retarded fields and the other to advanced fields, the equations of motion are differential equations. These differential equations are solved in the center-of-momentum frame by the elementary method of finding integrating factors. Solutions in an arbitrary Lorentz frame are found by a method which parametrizes the world lines on the particle velocities. All of the constants of the motion contain interaction contributions; this appears to be a characteristic feature of relativistic particle dynamics. (auth)

Quantum Field Theory

Refer also to abstracts 51876, 51884, 52029, 52215, and 52236.

52175 (PAM-70-3) SOME SINGULARITIES OF VECTOR FIELD THEORY. Houard, J. C. (College de France, Paris. Laboratoire de Physique Atomique et Moleculaire). Jun 1970. 35p. (In French). Dep. CFSTI (U. S. Sales Only).

An attempt was made to relate the existence of a ghost with zero mass, which appears in the canonical quantization of a massive vector field coupled to a Dirac current, with the possible occurrence of a kinematical singularity in the form factors of the vector meson. To support this view a limiting process allowing one to consider this theory as the limit of a theory in which finite energy poles occur in the vertex functions was constructed. (France)

52176 (SLAC-PUB-795) QUANTUM ELECTRODYNAMIC THEORY: ITS RELATION TO PRECISION LOW ENERGY EXPERIMENTS. Brodsky, Stanley J. (Cornell Univ., Ithaca, N. Y. Lab. of Nuclear Studies. Stanford Linear Accelerator Center, Calif.). Aug 1970. 33p. (CONF-700822-1). Dep. CFSTI.

From International Conference on Precision Measurement and Fundamental Constants, Gaithersburg, Md.

Recent developments in the precision tests of quantum electrodynamics are reviewed. These tests are the anomalous magnetic moments and the Lamb shift and fine structure of hydrogenic atoms. (J.F.P.)

52177 (TID-25473(Vol.4), pp 101-9) QED EXPERIMENTS WITH MUONS. Chen, K. W. (Princeton Univ., N. J.).

Muon experiments primarily studying quantum electrodynamics (QED) at small distances or μ–e differences are considered. Several of these experiments appear attractive at NAL without regard to the storage-ring considerations. The quality of muon beam required and sensitivity of the experiments to QED breakdown are presented. (auth)

52178 CONFORMAL INVARIANCE IN CLASSICAL MECHANICS. Hillion, Pierre. Compt. Rend., Ser. A; 271: 297-300(27 Jul 1970). (In French).

The conditions under which relativistic classical mechanics is invariant under the conformal group were studied. (France)

52179 CORRESPONDENCE BETWEEN THE FIRST- AND SECOND-QUANTIZED THEORIES OF PARAPARTICLES. Stolt, Robert H.; Taylor, John R. (Univ. of Colorado, Boulder). Contract AFOSR-30-67. Nucl. Phys.; B19: 1-19(1970).

It is shown that the parabosons and parafermions of the second-quantized parafield theory are equivalent to the finite-order paraparticles of the first-quantized theory. The prescription of Hartle and Taylor is followed which eliminates the redundancy of the generalized ray from the first-quantized formalism. For each statistical type of particle this allows an isomorphism to be established between the state spaces of the two theories, in such a way that all corresponding observables have identical matrix elements for all states. This means that any system of finite-order particles can be equally well described by either the first- or the second-quantized formalism, in the same sense as applied to ordinary bosons and fermions. The different conclusions reached by other authors are analyzed and the reasons for the disagreement are explained. (auth)

52180 EQUAL-TIME SINGULARITIES IN RENORMALIZED QUANTUM FIELD THEORY. Lukierski, J. (CERN, Geneva). Nuovo Cim.; 69A: 632-50(21 Oct 1970).

The notion of equal-time singularity replacing for the commutator of renormalized local field operators the notion of equal-time limit is studied. It is shown that in the Wightman framework the equal-time singularity is described by a finite number of one-dimensional tempered distributions. (auth)

52181 LOCAL QUANTUM THEORY. Course XLV of Proceedings of the International School of Physics Enrico Fermi, Varenna, Italy, 12th–24th August 1968. Jost, R. (ed.). New York; Academic Press Inc. (1969). 278p. $14.50.

The school included nine lectures. Separate abstracts were prepared for six lectures. Other lectures were algebras of operators, equations with partial derivatives, and integration in function space. (J.F.P.)

For abstracts of individual lectures see: 52154, and 52182–52186.

52182 LOCAL QUANTUM THEORY. I. Araki, H. (Kyoto Univ.). Rend. Scu. Int. Fis. Enrico Fermi; 45: 65-96(1969).

A brief survey of standard results in local quantum field theory is presented. The basic axioms, scattering theory, analyticity, and algebraic aspects are discussed. (J.F.P.)

52183 MODELS FOR QUANTUM FIELD THEORY. Glimm, J. (New York Univ., N. Y.). Rend. Scu. Int. Fis. Enrico Fermi; 45: 97-119(1969).

Some progress recently made in three models for quantum field theory is described: the Yukawa interaction in two-dimensional space-time and the ϕ^4 interaction in two and three dimensions. It is shown that the renormalized Hamiltonian exists and is a positive self-adjoint operator. An ultimate objective is to verify the axioms of quantum field theory, show the existence of an S-matrix, and justify the asymptotic validity of its perturbation theory. (L.B.S.)

52184 CONSTRUCTING THE $\lambda(\phi^4)_2$ THEORY. Jaffe, A. M. (Harvard Univ., Cambridge, Mass.). Rend. Scu. Inst. Fis. Enrico Fermi; 45: 120-51(1969).

Some problems connected with the formulation of a model quantum field theory that satisfies the requirements of Hilbert space, Lorentz covariance, positive energy, and locality are pointed out. It is shown that a local quantum theory corresponding to the $\lambda(\phi^4)_2$ field can be constructed that satisfies most of the requirements. (L.B.S.)

52185 EUCLIDEAN QUANTUM FIELD THEORY. Symanzik, K. (New York Univ., N. Y.). Rend. Scu. Int. Fis. Enrico Fermi; 45: 152-226(1969).

A detailed comparison is made of Euclidean quantum field theory with the Minkowski quantum field theory approach of Glimm and Jaffe, which shows the extent to which the two approaches are complementary. (L.B.S.)

52186 REMARKS ON THE OPERATOR SOLUTION OF THE SCALAR-FIELD MODEL. Guenin, M. (Univ., Geneva). Rend. Scu. Int. Fis. Enrico Fermi; 45: 234-46(1969).

A complete and explicit solution is given of the scalar-field model; both the operator solution and the n-point functions are given. It is then shown how the solution can be renormalized as the cut-off is removed, and also that the renormalized solution is a good distribution. (L.B.S.)

52187 RENORMALIZATION AND GAUGE INVARIANCE IN QUANTUM ELECTRODYNAMICS. Maris, Th. A. J.; Dillenburg, D.; Jacob, Gerhard (Univ. Federal do Rio Grande do Sul, Porto Alegre, Brazil). Nucl. Phys.; B18: 366-89(1970).

The connection between the field theory and the perturbation expansion of quantum electrodynamics is studied. As a starting point the usual Lagrangian is taken but with the bare electron mass and the renormalization constant Z_3 set equal to zero. This theory is essentially equivalent to the usual one; however, it does not contain any constant of nature and is dilatational and gauge invariant, both invariances being spontaneously broken. The various limiting procedures implied by the differentiation, the multiplication, and the renormalization of the field operators in the Lagrangian are combined in a gauge invariant way to a single limit. Propagator equations are derived which are the usual renormalized ones, except for: (i) a natural cancellation of the quadratic divergence of the vacuum polarization; (ii) the presence of an effective cutoff at $p \approx \epsilon^{-1}$; (iii) the replacement of the renormalization constants Z_1 and Z_2 by one gauge dependent function $Z(\epsilon^2)$; (iv) the limit $\epsilon \to 0$ which has to be taken. The value $Z(0)$ corresponds to the usual constants Z_1 and Z_2. It is expected that in general $Z(0) = 0$, but this poses no problem in the present formulation. It is argued that the function $Z(\epsilon^2)$, which is determined by the equations, may render the vacuum polarization finite. One may eliminate the renormalization function from the propagator equations and then perform the limit $\epsilon \to 0$; this results in the usual perturbation series. However, the renormalization function is essential for an understanding of the high momentum behavior and of the relation between the field theory and the perturbation expansion. (auth)

52188 FERMION PROPAGATOR OF QUANTUM ELECTRODYNAMICS IN AN ARBITRARY GAUGE. Dillenburg, D.; Maris, Th. A. J. (Univ. Federal do Rio Grande do Sul, Porto Alegre, Brazil). Nucl. Phys.; B18: 390-402(1970).

The fermion propagator equation derived in the preceding paper was solved using the following approximations: (i) the free photon propagator in an arbitrary gauge is used: (ii) for the vertex a functional of the fermion propagator which approximately obeys the Ward–Takahashi identity is taken; (iii) in the resulting equation a small term is neglected. Closed expressions for the fermion propagator and the renormalization function are obtained in an arbitrary gauge. The gauge dependence found for the fermion propagator is in agreement with the one which follows directly from the gauge transformation of the time ordered product defining the propagator. One recovers the well-known result that $Z_1 = Z_2 (= Z(0))$ can only be a finite non-zero number in one special gauge. From a discussion of the operator gauge transformation it seems likely that this finite gauge is non-physical and that in all physical gauges the electron propagator is more singular than the free one and that $Z(0) = 0$. In contradistinction to the usual situation this result causes in the present formulation no difficulty and may be essential for the finiteness of the vacuum polarization. (auth)

52189 QUANTUM FIELD THEORY OF COMPLEX MASS. Yamamoto, Hiroshi (Fukui Univ., Japan). Progr. Theor. Phys. (Kyoto); 44: 272-83(Jul 1970).

General properties of a complex massed particle are studied. The microcausality is reconsidered briefly and the macrocausality in this sense is defined in a very simple way. It is then examined whether a particle with a complex mass violates the macrocausality, and the demand not to violate the macrocausality gives a condition for the complex mass. The canonical quantization is applied to a field with complex mass. In this case the vacuum is defined carefully so that the propagator does not diverge in infinite past and future. A new propagator which eliminates the divergence from the usual field theory is introduced using the complex massed fields aside from the usual field with real mass. A new interpretation on the internal structure of elementary particles is suggested from this propagator and a more generalized propagator of a nonlocal field. It is proved that the scattering matrix defined as usual is unitary in the subspace of real massed particles. (auth)

52190 LISP AND ITS APPLICATIONS TO PHYSICAL PROBLEMS. Campbell, J. A. (Univ. of Texas, Austin). Comput. Phys. Commun.; 1: 251-64(Apr 1970).

The language LISP 1.5 is proposed as a standard language for writing computer programs which involve the manipulation of symbolic expressions as well as numbers. The elements of LISP are presented, and program construction is described. LISP programs exist which can perform difficult problems in quantum electrodynamics, from constructing the necessary Feynman diagrams to evaluating the trace of a product of Dirac matrices — determination of the part of the electron magnetic moment which is proportional to e^8 is an example. Another application of LISP is the determination of the "atomic associations" of multicentered molecules preparatory to calculating the energy surfaces of these molecules. (R.W.R.)

52191 COMPOSITE BOSONS IN NONLOCAL QUANTUM FIELD THEORY WITH $Z_3 \approx 1$. La Camera, M.; Wataghin, A. (Univ., Genoa. Instituto Nazionale di Fisica Nucleare, Genoa). Lett. Nuovo Cim.; 4: 693-6(10 Oct 1970).

A self-interacting Dirac field with four-fermion coupling is considered. It is assumed that the interaction is strong enough to produce a stable pseudoscalar boson bound state from a fermion-antifermion pair. It is shown that the four-fermion interaction can be replaced by an equivalent Yukawa coupling, that in the nonlocal quantum field theory used the mass of the fermion is $\approx 1m_p$, and that the result is independent of the compositeness condition $Z_3 = 0$. Instead it is shown that $Z_3 = [1/(1 + 1/G_R^2)]$, which solves the difficulties in local quantum field theory with the relation $Z_3 = 0$. (J.F.P.)

52192 ASYMPTOTIC BEHAVIOR OF FOURIER TRANSFORMS. Brychkov, Yu. B.; Shirokov, Yu. M. (Inst. of Mathematics, Moscow). Teor. Mat. Fiz.; 4: 301-9(Sep 1970). (In Russian).

The notion of the asymptotics of a generalized function is introduced. The mathematical framework is presented of the new approach to investigation of analytical properties of quantum field matrix elements. The approach is based on the connection between the singularities of the generalized function and the behavior of its Fourier-transform at the infinity. (auth)

52193 MICROCAUSALITY, KRAMERS' THEOREM, AND THE BOUND-STATE BETHE–SALPETER EQUATION. Allcock, G. R. (Univ. of Liverpool); Leigh, W. J. Nucl. Phys.; B19: 413-31(1970).

The explicit role of microcausality in exact bound-state Bethe–Salpeter schemes is examined. It is found to lead to covariant analyticity properties of Bethe–Salpeter momentum-space amplitudes which, it is suggested, can be used to judge the structural consistency of approximate schemes. It is argued in general that the structure of the exact scheme is retained by those approximations obtained by finite order truncation of graphical series. The additional implications of time-reversal invariance are also considered and a relativistic extension of the configuration-space Kramers theorem is established. Finally, explicit examination of the Wick–Cutkosky model solutions is made: all such solutions, both normal and abnormal, are shown to display the requisite analyticity, microcausality, and time-reversal properties. (auth)

52194 GAUGE FIELDS AND GOLDSTONE BOSONS IN THE NAMBU MODEL. Freundlich, Y.; Lurie, D. (Technon–Israel Inst. of Tech., Haifa). Nucl. Phys.; B19: 557-67(1970).

A vector-gauge particle is coupled to the current associated with the broken symmetry in the model of Nambu and Jona–Lasinio in which the symmetry-breaking scalar field is a bilinear combination of fermion fields. The model is treated in the pair approximation. As in models involving the Goldstone bosons as elementary fields, all massless particles are eliminated. The gauge particle absorbs the Goldstone particle to become a massive vector particle. (auth)

52195 ABOUT CHARGED TACHYONS. Baldo, M.; Fonte, G.; Recami, E. (Univ., Catania, Italy). Lett. Nuovo Cim.; 4: 241-7(8 Aug 1970).

It is pointed out that tachyons are not necessarily neutral. It is shown that it would be possible to define a charge operator Q, for a set of interacting particles including tachyons, which commutes with the total Hamiltonian but no longer with the generic Lorentz boost. A set of scalar tachyons is considered. (J.F.P.)

52196 SCATTERING FORMALISM FOR NONLOCALIZABLE FIELDS. Steinmann, O. (SIN, Zurich). Commun. Math. Phys.; 18: 179-94(1970).

The theory of a nonlocalizable relativistic quantum field is considered. Nonlocalizability means that the field is not a tempered distribution, but increases strongly for large momenta. Local commutativity can then not be satisfied. Instead the existence of Green's functions with the usual analyticity properties is assumed. It is shown that in such a theory the S-matrix can be defined, and its elements can be expressed in terms of the fields by the usual reduction formulas. (auth)

52197 SMALL DISTANCE BEHAVIOR IN FIELD THEORY AND POWER COUNTING. Symanzik, K. (Deutsches Elektronen-Synchrotron, Hamburg). Commun. Math. Phys.; 18: 227-46 (1970).

For infinitesimal changes of vertex functions under infinitesimal variation of all renormalized parameters, linear combinations are found such that the net infinitesimal changes of all vertex functions are negligible relative to those functions themselves at large momenta in all orders of renormalized perturbation theory. The resulting linear first-order partial differential equations for the asymptotic forms of the vertex functions are, in quantum electrodynamics, solved in terms of one universal function of one variable and one function of one variable for each vertex function whereby, in contrast to the renormalization group treatment of this problem, the universal function is obtained from nonasymptotic considerations. A relation to the breaking of scale invariance in renormalizable theories is described. (auth)

52198 PARASTATISTICS. Druehl, K.; Haag, R.; Roberts, J. E. (Univ., Hamburg). Commun. Math. Phys.; 18: 204-26 (1970).

The physical content of a para-Fermi field theory is analyzed from the point of view of its local observables. The parafield theory leads to parastatistics only for special choices of the observable algebra, and only then does it give a complete description of the relevant physical states. On the other hand there is always a physically equivalent description in terms of a certain number of ordinary Fermi fields from which the observables are selected by a gauge group (in general non-Abelian). Thus one can always achieve a reduction to Fermi statistics by considering a system with different particle types which are distinguished by hidden (unobservable) quantum numbers. (auth)

52199 ZERO-MASS INFINITE-SPIN REPRESENTATIONS OF THE POINCARE GROUP AND QUANTUM FIELD THEORY. Yngvason, Jakob (Univ., Goettingen, Ger.). Commun. Math. Phys.; 18: 195-203(1970).

It is shown that a local quantized field with a manifestly covariant transformation law under the Poincaré group cannot have nonvanishing matrix elements between the vacuum and an irreducible subspace of zero mass and infinite spin. (auth)

Gravitation and General Relativity

Refer also to abstracts 51380 and 51869.

52200 INTEGRAL CONSERVATION LAWS FOR CONTINUOUS MEDIA IN GENERAL RELATIVITY. Zhelnorovich, V. A. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 186: 50-3(1 May 1969). (In Russian).

A new method is suggested for obtaining integral conservation laws based on a variable concept coupled with univalued determinant canonic equations. (R.V.J.)

52201 USEFUL FORM OF THE MINKOWSKI DIAGRAM. Parker, Leonard; Schmieg, Glenn M. (Univ. of Wisconsin, Milwaukee). Amer. J. Phys.; 38: 1298-1302(Nov 1970).

A diagrammatic representation of the diagonal form of the special Lorentz transformation is given. The null coordinates $x \pm ct$ are plotted along a single set of orthogonal axes. Special Lorentz transformations are then represented only by a change of scale along those orthogonal axes. This diagram, which is called a null coordinate diagram, and the Minkowski diagram are closely connected. To demonstrate the use of the null coordinate diagram, it is applied to the linear Doppler effect, time dilation, and Lorentz contraction. (auth)

52202 DISCONTINUITY OF FIRST DERIVATIVES OF METRIC TENSOR AND MACH'S PRINCIPLE. Kumar, M. M. (Munshi Singh Coll., Motihari, India). Progr. Theor. Phys. (Kyoto); 44: 243-53(Jul 1970).

A static massive thin spherical shell in a universe empty, except for the shell, is constructed which provides suitable boundary conditions that enforce Mach's principle in general relativity. The momentum-energy tensor of the surface distribution on the shell is given by the terms containing δ-function, that appear in Einstein's field equations if the first derivatives of the metric tensor are discontinuous across the interface of the two adjacent regions. Einstein's field equations, in this case are constructed from the metric tensor which is a linear combination of two metric tensors specifying two adjacent regions, making use of the step-function. This method of constructing the field equation is the same as has been followed previously. (auth)

52203 IS RAINICH'S THEORY TENABLE? Klotz, A. H.; Lynch, J. (Univ. of Sydney). Lett. Nuovo Cim.; 4: 248-50(8 Aug 1970).

A solution is found which justifies a previous objection to a certain unified field theory on the grounds that it implied a strong interdependence of gravitational and electromagnetic fields. The method chosen is that of perturbation on a static spherically symmetric field. (J.F.P.)

52204 RARITA-SCHWINGER FIELDS IN GENERAL RELATIVITY. Lawrence, J. K. (Univ. of Vienna). Acta Phys. Pol.; B1: 247-59(Jul-Sep 1970).

An investigation is made of the possibility of extending a previous calculation of the motion of fermions in a linearized gravitational field to particles of higher spin. The Rarita-Schwinger equations or arbitrary half-integral spin are discussed. It is found that the R-S equations for spin $> 3/2$ become self-inconsistent in the presence of gravitational field with other than constant Riemann curvature. For spin $3/2$ the equations are seen to be consistent in the presence of an exterior gravitational field in regions where the sources vanish. The equations for the trajectory of a spin $3/2$ particle in such a situation are calculated and take the same form as in the spin $1/2$ case with the appropriate generator of Lorentz transformations appearing in the spin tensor. The deflection of high energy spin $3/2$ particles passing near a massive body is computed. Although the corresponding equations for the trajectory of a spin 1 particle can be shown to have the same form as the spin $1/2$, $3/2$ cases, it is doubtful whether the result will hold for spins $> 3/2$, except in fields of constant Riemann curvature. (auth)

52205 SCALAR-TENSOR THEORY IN CANONICAL FORM. II. EXACT SOLUTIONS FOR A STATIC SPHERICALLY SYMMETRIC CHARGED MASS DISTRIBUTION. Toton, Edward T. (Univ. of Maryland, College Park). J. Math. Phys. (N. Y.); 11: 2818-25(Sep 1970).

Variational techniques are used to generate the differential equations determining the static fields of a charged mass distribution. The equations are solved external to the source by the Hamilton-Jacobi method under the conditions of spherical symmetry. Solutions for a charged mass shell are investigated, the rigorous solution for the electron in general relativity is given and, by limit arguments, it is shown that the same external solution arises for the electron in the scalar-tensor theory. (auth)

52206 EINSTEIN SPACES WITH SYMMETRY GROUPS. Kerr, R. P. (Univ. of Texas, Austin); Debney, G. C., Jr. J. Math. Phys. (N. Y.); 11: 2807-17(Sep 1970).

All possible groups of motion (symmetry groups) for empty Einstein spaces are constructed admitting a diverging, geodesic and shear-free ray congruence. (Minkowski space is excluded throughout the discussion.) It is proved that any such Einstein space cannot admit a symmetry group with dimension greater than four. Although the field equations are not solved completely for spaces with groups of dimension one or two, a generalization of the Kerr spinning-mass solution is obtained from the 2-dimensional class. It is shown that all such spaces with 4-dimensional symmetry groups are well known: Schwarzschild, NUT (Newman, Unti, and Tamborino), and a particular hypersurface orthogonal Kerr-Schild metric. The only member of these spaces admitting a 3-dimensional symmetry group is a Petrov Type III hypersurface orthogonal metric. (auth)

52207 SL(2,C) SYMMETRY OF THE GRAVITATIONAL FIELD DYNAMICAL VARIABLES. Carmeli, Moshe (Aerospace Research Labs., Wright-Patterson AFB, Ohio). J. Math. Phys. (N. Y.); 11: 2728-32(Sep 1970).

The spin coefficients and the Riemann tensor are represented in the form of linear combinations of the infinitesimal generators of the group SL(2,C). This representation is similar to the way Yang and Mills write their dynamical variables in terms of the Pauli spin matrices. The spin coefficients take the role of the Yang-Mills-like potentials, whereas the Riemann tensor takes the role of the fields. (auth)

52208 GLOBAL SINGULARITIES AND THE TAUB-NUT METRIC. Feinblum, David A. (State Univ. of New York, Albany. Weizmann Inst. of Science, Rehovot, Israel). J. Math. Phys. (N. Y.); 11: 2713-21(Sep 1970).

Several examples of singular behavior which are not apparent in the line element are discussed. It is shown that the presence of

such singularities depends on the manner in which coordinate patches are assembled to form the entire manifold. It is shown that the usual connection of a coordinate patch with the Taub metric to a patch with the NUT metric is singular in the sense of this particle. (auth)

Scattering Theory

Refer also to abstracts 52005, 52196, and 52689.

52209 (CNRS-CPT-70-P-330) APPLICATIONS OF THE THEORY OF DIRICHLET SERIES TO THE SUPERPOSITION OF AN INFINITE NUMBER OF REGGE POLES. Mandelbrojt, J.; Mandelbrojt, S. (Centre National de la Recherche Scientifique, Marseilles (France). Centre de Physique Theorique). 1970. 17p. Dep. CFSTI (U. S. Sales Only).

The theory of Dirichlet series is the most fruitful general framework for studying the superposition of an infinite number of Regge poles. A theorem was given which shows that daughter trajectories spaced by one unit are introduced in the theory of Dirichlet series, in a natural way. The intercept of the daughter trajectories in the Chew Frautschi plot for every value of t was studied. The daughter trajectories asymptotically in n were shown to be parallel and spaced by one unit. (France)

52210 (PAM-70-1) RELATIVISTIC EXTENSION OF THE LE COUTEUR AND NEWTON FORMALISM. VIII. DETERMINANTAL FORMALISM AND PHYSICAL UNITARITY. Benayoun, M.; Leruste, Ph. (College de France, Paris. Laboratoire de Physique Atomique et Moleculaire). Apr 1970. 31p. (In French). Dep. CFSTI (U. S. Sales Only).

Topics concerning the assumption of physical unitarity were examined. It was essentially proved that the general description of the n-channel scattering needs n many valued meromorphic functions. Only a part of the set of the branches of these functions was shown to appear in the physical quantities. A special consequence of the physical unitarity was examined. Under this hypothesis the physical quantities of the second elastic channel may diverge at the second threshold energy in the 2 channel scattering problem (S_{22}, K_{22}, T_{22}, σ $(2 \rightarrow 2)$). (France)

52211 (PAM-70-7) POLOLOGY, FACTORIZATION, AND UNITARITY. Benayoun, M.; Leruste, Ph. (College de France, Paris. Laboratoire de Physique Atomique et Moleculaire). Jul 1970. 22p. (In French). Dep. NTIS (U. S. Sales Only).

Factorization theorems were proved with the only hypotheses of extended unitarity and T-invariance, generalizing in this way the factorization of the residue theorem and the dipole coefficient factorization of Rebbi and Slanski. The weak Levinson condition was shown to imply restrictions on S, T and K matrices. The hypotheses underlying the one or many level Breit-Wigner formula were clearly established. The link between poles of the K-matrix and zeros of the D-function was exhibited, and the arbitrariness in the choice of phase space factors was somehow analyzed. (France)

52212 VARIATIONAL SOLUTION OF THE FADDEEV EQUATIONS FOR LOCAL POTENTIALS. Bhakar, B. S.; Delves, L. M. (Univ. of Sussex, Eng.). pp 20-5 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

The Faddeev equations for an arbitrary interaction reduce to a set of coupled three-dimensional integral equations. Current computational approaches to these equations involve forming an expansion in the two-body angular momenta, yielding an infinite set of two-dimensional equations which is then truncated. A variational procedure which handles directly the three-dimensional form of the equations is described. Such an approach has major advantages when the numerical complications attendant on the nucleon spin and noncentral forces are introduced. The numerical experience gained so far with the method is described. 4 references. (auth) (UK)

52213 EIGENFUNCTION ANALYSIS OF THE TWO-BODY t-MATRIX. Osborn, T. A. (Oxford Univ.). pp 332-6 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

An eigenfunction analysis of the off-shell partial wave two-body t-matrix is presented. The intention is to construct a general finite rank separable approximation for the two-body t-matrix that is suitable for use in numerical solutions of Faddeev's equation. This is done by extending the single term separable approximation suggested by Kowalski and Noyes. It is proved that if the potential satisfies the conditions stated by Faddeev then the kernel in the Kowalski-Noyes equation, A(s), is compact and has an eigenfunction representation. The extension of the Kowalski-Noyes approximation adds additional separable terms composed of the eigenfunctions of A(s). It is shown that the nonphysical poles which occur in the single term separable approximation are cancelled by these additional separable terms. (auth) (UK)

52214 SOME GENERAL PROPERTIES OF THE CROSSING RELATIONS. Immirzi, Giorgio (University Coll., London). Nucl. Phys.; B17: 515-24(1970).

The derivation of the crossing relations for helicity amplitudes is analyzed and a set of identities is proved which relate the crossing angles to each other and to other kinematic variables. The expressions derived make the behavior of the crossing angles at kinematically "critical" points particularly transparent. The derivation is presented using Toller's M-amplitude formalism. The geometric meaning of the relations obtained is explained using the relativistic velocity diagram for a two-body process, with particular emphasis on the t = 0 behavior of the variables involved. (auth)

52215 HIGH-ENERGY BEHAVIOUR AT FIXED ANGLE IN PERTURBATION THEORY. Cardy, J. L. (Cambridge Univ., Eng.). Nucl. Phys.; B17: 493-514(1970).

A study is made of the high-energy behavior of the elastic two-particle amplitude at fixed scattering angle, in both a simple ϕ^3 model and in quantum electrodynamics. In the first case, diagrams associated with the Born terms are shown to dominate. In the second, electron-electron scattering is shown to exhibit a power-law dependence on the energy, more rapidly decreasing than that of the Born terms alone. (auth)

52216 GENERAL MULTI-LOOP VENEZIANO AMPLITUDE. Kaku, M.; Yu, L. (Univ. of California, Berkeley). Contract F44620-70-C-0028. Phys. Lett.; 33B: 166-70(28 Sep 1970).

The planar and nonplanar multi-loop Veneziano amplitude is presented in a manifestly projectively invariant and cyclically symmetric fashion. The planar, nonplanar, and overlapping loop amplitudes are found to differ chiefly in the limits of integration. (auth)

52217 UNITARITY IN DUAL RESONANCE MODELS. Di Giacomo, A.; Fubini, S.; Sertorio, L.; Veneziano, G. (CERN, Geneva). Phys. Lett.; 33B: 171-4(28 Sep 1970).

Some elementary consequences of the fact that all excited levels in dual resonance models are fundamentally unstable are discussed. The results are relevant in order to understand the role of unitarity in the framework of these schemes. (auth)

52218 PADE METHOD FOR THE PHASE EQUATION WITH SINGULAR POTENTIALS. Kloet, W. M.; Zimerman, A. H. (Instituto de Fisica Teorica, Sao Paulo, Brazil). Nuovo Cim.; 69A: 564-8(21 Oct 1970).

The possibility is considered of applying Padé approximants for the phase equation with singular potentials. Some examples are considered which show that it is possible to obtain good results.

52219 HIGH-ENERGY BEHAVIOR OF FEYNMAN GRAPHS AND THE EIKONAL APPROXIMATION. Nicoletopoulos, P.; Prevost, M. A. L. (Univ. Libre, Brussels). Nuovo Cim.; 69A: 665-85(21 Oct 1970).

The fixed-t high-s behavior of individual graphs contributing to the eikonal approximation is calculated up to 3rd order. It is shown that the mechanism which cancels the Regge cut in the AFS diagram is also responsible for the leading behavior of each graph but is irrelevant to the eikonal model. (auth)

52220 APPLICATION OF S-MATRIX APPROACH TO DESCRIPTION OF BOUND STATES AND STATES OF SCATTERING. Borisov, N. D. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; No. 3, 59-65(May-Jun 1969). (In Russian).

The S-matrix concept was used in studies of bound and scattering states in systems with a variable number of particles: the S-matrix was sought for as a quantity ordered in accordance with normal products of operators. The transition from unhomogeneous system of linked equations for S-matrix elements to homogeneous was found and used in order to find the intrinsic energy and probability of various processes in the investigated system. (tr-auth)

52221 OPERATOR FORMALISM METHOD FOR SUMMATION DIAGRAM. Komarov, V. V.; Popova, A. M. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; No. 3, 34-41(May-Jun 1969). (In Russian).

Operator formalism of graph summation method was developed within the limits of four-dimensional theory of perturbations and equations were obtained for several particle scattering amplitudes.

The developed formalism corresponds to the method of summation of nonrelativistic diagrams previously suggested for finding scattering amplitudes of three or four fields. (R.V.J.)

52222 DUAL LOOP AMPLITUDES WITH GENERAL REGGE TRAJECTORIES. Olesen, P. (CERN, Geneva). Nucl. Phys.; B18: 473-85(1970).

Previously constraints were obtained on Regge intercepts from factorization of the N-point dual amplitude. Here more general factorization properties are considered, and an expression is obtained for the loop amplitude with general (factorizable) Regge intercepts. It turns out that the loop amplitude is finite if the Regge intercepts satisfy a certain condition. If this condition is not satisfied a continuation procedure is given, which in principle allows one to calculate the loop amplitude (even if all intercepts are universal). However, in this case one encounters a cut which does not correspond to a physical singularity. (auth)

52223 LONG-RANGE PERTURBING FORCES AND THE N/D METHOD. Mehta, Naren; Poston, John R.; Squires, Euan J. (Univ. of Durham, Eng.). Nucl. Phys.; B18: 486-90(1970).

It is suggested that the inclusion of box-diagram contributions to the left-hand cut permits the removal of infra-red divergences in perturbation methods in an unambiguous way. The method is applied to potential models and yields satisfactory results. (auth)

52224 CONSTRAINTS ON REGGE TRAJECTORIES FROM FACTORIZATION OF THE N-POINT DUAL AMPLITUDE. Olesen, P. (CERN, Geneva). Nucl. Phys.; B18: 459-72(1970).

The factorization properties of the N-point Veneziano amplitude with general Regge trajectories are investigated. The intercepts turn out to be polynomial functions of the quantum numbers of the constituent particles. From a comparison of the level density with the Hagedorn temperature it is argued that the polynomial is quadratic. A five-dimensional harmonic oscillator formalism is given for the factorization of the N-point amplitude with the intercepts as quadratic functions of the constituent particles. Factorizable production amplitudes with satellite terms are investigated in an n-dimensional harmonic oscillator formalism, and it is shown that the level density is incompatible with the Hagedorn temperature. (auth)

52225 MODEL CALCULATION WITH PERTURBED DISPERSION RELATIONS. Mehta, N.; Watson, P. J. S. (Univ. of Durham, Eng.). Nucl. Phys.; B18: 585-94(1970).

A method of handing perturbations in dispersion theory is suggested and compared with a potential theory model where it is shown to be rather more accurate then previous methods. The problem of the divergences due to Coulomb interactions is discussed, and it is suggested that it may be handled by a comparatively trivial method. (auth)

52226 EIGEN FUNCTIONS IN THE THREE BODY PROBLEM. Nyiri, J.; Smorodinskii, Ya. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 12: 202-16(Jul 1970). (In Russian).

The transformation method of the eigenfunctions of the three-particle system with quantum numbers K, j_1, M_1, j_2, M_2 to the system of functions which realize simultaneously the representation of permutation group (quantum number ν) is described. The solution is reduced to the Fourier transformation. For the total transition to the K polynomials it is necessary to satisfy the eigenvalue equation of the operator Ω. (auth)

52227 PHASE OF THE FORWARD SCATTERING AMPLITUDE. Saleem, M.; Tirmazi, S. H.; Rafique, M. (Panjab Univ., Lahore). Lett. Nuovo Cim.; 4: 683-4(10 Oct 1970).

It is shown from a modified Pomeranchuk theorem that at high energies the phase of the forward scattering amplitude grows logarithmically with incident energy. This modified theorem also predicts that for particle–particle and particle–antiparticle reactions the positive and negative phases have the same sign asymptotically. It is noted that the failure of the conventional Pomeranchuk theorem and the logarithmic asymptotic behavior for the phase imply that the Regge theory cannot be applied for the whole amplitude. (J.F.P.)

52228 SIMPLE EXPRESSION FOR THE SCIUTO THREE-REGGEON VERTEX-GENERATING DUALITY. Della Selva, A.; Saito, S. (Istituto Nazionale di Fisica Nucleare, Naples. Univ., Naples). Lett. Nuovo Cim.; 4: 689-92(10 Oct 1970).

The structure of the three-Reggeon vertex is studied using a previously considered field. It is shown that the previously obtained vertex function can be written in an extremely simple form. (J.F.P.)

52229 SELF-REPRODUCING CONDITIONS ON THE POMERANCHUK SINGULARITY. Fujisaki, Haruo (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 44: 219-29(Jul 1970).

A "self-reproducing" bootstrap model is proposed for the Pomeranchukon, by the use of a Reggeization procedure of production amplitudes by Gribov, Pomeranchuk and Ter-Martirosyan. On the basis of the analysis of two Pomeranchukon contributions to the crossed-channel unitarity, it is shown that, in order to satisfy the "self-reproducing" condition, the Pomeranchukon must be a fixed branch point or two colliding branch points, with the intercept equal to 1. It is also argued that the discontinuity across the Pomeranchukon will not be determined by the unitarity alone. On the assumption of a standard form of the discontinuity, the model predicts two typical features of the diffraction scattering in the asymptotic energy region. First, the total cross sections decrease faster than 1/log s as s tends to infinity. Secondly, the ratio of real to imaginary parts of the forward amplitude is negative and decreases like 1/log s at large s. These predictions are irrespective of whether the Pomeranchukon is fixed or moving. (auth)

52230 EIGENCHANNELS AND UNITARY SEPARATION OF BACKGROUND PARTS IN REGGE-POLE THEORY. Konisi, Gaku (Kwansei Gakuin Univ., Nishinomiya, Japan); Saito, Takesi. Progr. Theor. Phys. (Kyoto); 44: 230-42(Jul 1970).

It is shown that in multichannel scattering, background parts can be separated from a Regge-pole term in such a way that the background parts are unitary for any energy and for any angular momentum. To show this it is necessary to prove some theorems concerning the analytic continuation of amplitudes into the complex angular-momentum plane, factorizability of the Regge residue, analyticity of the eigenchannel S-matrix, and analyticity of the diagonalization matrix of the amplitudes. (auth)

52231 APPROXIMATION OF VIRTUAL-PARTICLE PROPAGATORS AND HIGH-ENERGY BEHAVIOR OF FEYNMAN DIAGRAMS. Barbashov, B. M.; Nesterenko, V. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 4: 293-300(Sep 1970). (In Russian).

The high energy ($s \to \infty$, t fixed) behavior of Feynman graphs in the model $L_{int} = g{:}\,\psi^2(x)\phi(x)$ is studied with respect to the following modification of all virtual particle propagators: $\{1/[(p + \Sigma_i k_i)^2 - m^2 + i\epsilon]\} \to [1/(\Sigma_i k_i^2 + 2p\Sigma_i k_i + i\epsilon)]$ (where $p^2 = m^2$ and k_i are the momenta of the virtual particles). It is shown that this modification of propagators does not change the asymptotics of the planar and quasi-planar graphs of the ladder type. For the diagrams possessing crossing lines this assertion is proved in the lowest orders of perturbation theory. (auth)

52232 SECOND BORN APPROXIMATION FOR PHASE SCATTERING ON SMOOTH POTENTIALS. Savrin, V. I.; Tyurin, N. E.; Khrustalev, O. A. (Inst. of High-Energy Physics, Moscow). Teor. Mat. Fiz.; 4: 322-7(Sep 1970). (In Russian).

The phase of the scattering on smooth potentials in the second Born approximation is evaluated and the contribution of this approximation into scattering amplitude for small angles is discussed. (auth)

52233 CONSTRAINTS ON REGGE TRAJECTORIES FROM FACTORIZATION OF THE N-POINT DUAL AMPLITUDE. II. CONSISTENCY CONDITIONS FOR TRAJECTORIES. Olesen, Poul (CERN, Geneva). Nucl. Phys.; B19: 589-610(1970).

The discussion given previously of the factorization properties of the N-point dual amplitude with general Regge trajectories is continued. The most general solution compatible with the Hagedorn temperature is found. Consistency for the various couplings of trajectories to the external particles is found to impose selection rules on the total-intercept quantum number. The number of identical external particles has to be even. If the level density is in complete agreement with the Hagedorn level density, the intercept quantum numbers for a given N-point function are conserved. Such a model gives meson trajectories which resemble those found in nature. Other models exist where the intercept quantum numbers are partially conserved. In these models the Hagedorn level density is satisfied for most trajectories, but for very low-lying trajectories there are deviations. The spectrum of Regge trajectories again resembles that found in nature (for mesons). A concrete example of a finite loop is given in a model with partially conserved trajectory quantum numbers. (auth)

52234 REGGE TRAJECTORIES FOR MULTICHANNEL SCATTERING. Capri, A. Z.; Kreuzer, H. J.; Teshima, R. (Univ. of Alberta, Edmonton). Lett. Nuovo Cim.; 4: 271-5(8 Aug 1970).

The generalization of nonrelativistic potential scattering to two-body multichannel scattering in order to obtain a more realistic model for high-energy scattering is discussed. Two- and three-channel calculations are performed with a simple potential which

is a modified version of the Yanaguchi potential. The Regge trajectories for these calculations are shown. (J.F.P.)

52235 INDEFINITELY OSCILLATING BEHAVIOR AT HIGH ENERGY AND NONZERO MOMENTUM TRANSFER. Cornille, H. (Institut de Physique Nucleaire, Orsay, France). Lett. Nuovo Cim.; 4: 267-70(8 Aug 1970).

The possibility of an infinity of oscillations for $d\sigma^{el}/dt$ in t as $s \to \infty$ starting from a particular nonoscillating forward behavior (where S and t are the usual Mandelstam variables) is discussed. Casella-like models are extended to nonoscillating forward amplitudes other than that in which $\sigma_+ \simeq$ constant, $\sigma_+ - \sigma_- \simeq$ constant (where $\sigma_\pm$ are the total cross sections for particle–particle and particle–antiparticle scattering). These models have the same feature of $d\sigma^{el}/dt$ indefinitely oscillating and a $(\log s)^2$ shrinkage. Thus it is found that there exist cases where the standard Pomeranchuk theorems can be satisfied. (J.F.P.)

52236 MODEL WITH PERSISTENT VACUUM. Eckmann, J.-P. (Univ., Geneva). Commun. Math. Phys.; 18: 247-64(1970).

It is shown that there exists a selfadjoint Hamilton operator corresponding to the interaction $H_0^{(a)} + H_0^{(b)} + \int \Phi_b^+(\chi)\Phi_a(\chi)\Phi_b^-(\chi)d^3\chi$, where a and b denote two types of scalar particles. The scattering theory of this operator is discussed. (auth)

52237 MATHEMATICS OF THE N/D METHOD. Lyth, D. H. (Univ. of Lancaster, Eng.). J. Math. Phys. (N. Y.); 11: 2646-78(Sep 1970).

A complete mathematical account is given of the N/D method, subject to certain restrictions on the given functions L and ρ (left-hand cut contribution and phase-space factor). The restrictions are the weakest possible if the phase shift is to be Hölder continuous. Any asymptotic behavior $\rho \sim x^\beta$, $0 < \beta < 2$, is allowed. No analyticity is assumed for L. Exhaustive existence and uniqueness theorems are given: Any allowed function F ($= e^{i\delta} \sin \delta/\rho$) possesses an N/D decomposition, and the integral equation for N acts in a space of L_2 functions; this equation satisfies the Fredholm alternative theorems [though its kernel has a continuous spectrum if $\delta(\infty)/\pi$ is not integral]; any L_2 solution of the equation yields an allowed function F; all allowed solutions may be obtained by varying the CDD parameters (which enter linearly); each solution has a uniqueness index κ; there will usually be a κ parameter infinity of solutions with each $\kappa \geq 0$, and none with $\kappa < 0$, but precise conditions on L and ρ are given in order that there will be a negative κ solution. (auth)

52238 PHYSICAL-REGION DISCONTINUITY EQUATION. Coster, Joseph; Stapp, Henry P. (Univ. of California, Berkeley). J. Math. Phys. (N. Y.); 11: 2743-63(Sep 1970).

A Cutkosky-type formula for the discontinuity around an arbitrary physical-region singularity is derived from precisely formulated S-matrix principles. (auth)

52239 SOME TOPOLOGICAL PROPERTIES CONNECTED TO THE PARAMETRIZED FEYNMAN AMPLITUDES. Liu, C. J.; Chow, Yutze (Univ. of Wisconsin, Milwaukee). J. Math. Phys. (N. Y.); 11: 2789-99(Sep 1970).

An approach first developed previously for computation involving Poincaré incidence matrix is now carried over to the so-called "loop-matrix" formalism. A matrix $\begin{Bmatrix} \nu \\ r \end{Bmatrix}_{ij}$ is introduced to prove some important properties of transformations among different sets of basic loops. Several properties in the form of lemmas and theorems are presented. In particular, a formula of very concise form is found for the total number of possible tree graphs of a given Feynman graph in terms of its corresponding Poincaré incidence matrix. Also derived here is the formula for the total number of tree graphs in terms of any loop matrix. Their proofs show that the previously developed approach for Poincaré incidence matrix can be nicely generalized to a surprising extent to the loop matrix formalism and thus demonstrate the duality between the two formalisms. (auth)

52240 HYPERPLANE INDEPENDENCE OF THE SCATTERING AMPLITUDE. Fleming, Gordon N.; Miller, James T. Jr. (Pennsylvania State Univ., University Park). J. Math. Phys. (N. Y.); 11: 2826-9(Sep 1970).

In the context of the formal theory of scattering the scattering amplitude on the energy–momentum shell is shown to be hyperplane-independent even in the presence of hyperplane-dependent interaction "potentials." Also, a formal field-theoretic example of consistent hyperplane-dependent potentials is presented. (auth)

Particle Accelerators

Refer also to abstracts 50567, 50586, 50597–50611, 50614–50621, 50624, 50625, 50631, 50647, 51190, 51905, 51909, 51927, 52004, 52563, and 52566.

52241 (AD-705484) REPORT OF CYCLOTRON OPERATION, JULY 1–DECEMBER 31, 1969. (Naval Research Lab., Washington, D. C.). Mar 1970. 39p. (NRL-MR-2103). NTIS.

The various research programs using positive ion beams of the NRL Sector-Focusing Cyclotron are briefly described, together with facility development and operations for the period 1 July–31 December 1969. (auth) (USGRDR)

52242 (AD-706015) NRL VAN DE GRAAFF OPERATION, JULY 1–DECEMBER 31, 1969. Dunning, K. L. (Naval Research Lab., Washington, D. C.). Apr 1970. 28p. (NRL-MR-2124). NTIS.

The report is the fourth of a series of semiannual summaries on the use of the 5-MeV Van de Graaff accelerator and associated instruments. The period 1 July 1969 to December 31, 1969 is covered. A brief statistical summary is presented, a few important developments concerning the maintenance and improvement of apparatus are discussed, and brief accounts of on-going and recently completed research projects are given. (auth) (USGRDR)

52243 (CERN-70-26) NEW DISK-LOADED WAVEGUIDES FOR THE CERN RF SEPARATOR. Bernard, Ph.; Lengeler, H.; Vaghin, V. (European Organization for Nuclear Research, Geneva (Switzerland)). 17 Sep 1970. 39p. Dep. CFSTI (U. S. Sales Only).

Three new deflectors for the CERN RF separator have been designed and constructed. The deflection of particles will be nearly doubled compared to the situation with the old deflectors. It will be possible to change the phase velocity of the deflecting fields within some limits, as is necessary in more sophisticated applications of particle separation. This will be especially interesting for lower separation momenta and for deuteron rejection. The choice of the deflectors takes into account new experimental and theoretical results in the high power behavior of deflecting modes. New and refined methods for measurements on models, coupler matching and tuning of disk-loaded waveguides have been developed and allowed to achieve very uniform dephasings per cell (within ±2°) and very low standing wave ratios over a frequency range of several MHz. Problems of machining and brazing in a vacuum furnace are discussed briefly. A high power test on each of the three deflectors showed that they can be operated safely at the design RF power level of 20 MW, confirming fully our calculations and measurements on peak RF fields in disk-loaded waveguides. Results of a deflection test with 16 GeV protons were found to be in agreement within some per cent with computer calculations and measurements on models. The maximum transverse momentum given by one deflector to the particles is 24 MeV/c. A short description of the machining and brazing technique, the mechanical layout, the alignment system and the vacuum system is given. It is shown that the stability requirements for frequency and temperature can be easily fulfilled. Finally the formulae for the change of phase velocity of the deflecting fields are given. (auth)

52244 (CISE-N-139) PROJECT OF A 8 MeV TANDEM VAN DE GRAAFF. PART III. THE INJECTOR AND THE BEAM OPTICS. Cesati, A.; Cristofori, F.; Sona, P. G. (Centro Informazioni Studi Esperienze, Milan (Italy)). Jun 1970. 42p. Dep. CFSTI (U. S. Sales Only).

The injector, negative ion source, injection focusing system, optics of the second acceleration tube, and the focusing system after acceleration including electrostatic and magnetic elements are described. (W.H.K.)

52245 (CONF-671061-(Vol.3), pp 961-77) LINEAR ACCELERATORS. Bentz, Werner. (In German).

Linear accelerators have been used for many years for penetration testing of thick-walled structural pieces. The various models used in routine practice are described and the characteristic values of the beam energy and the beam output are given. The principle of kinetic voltage transformation with potential fields is outlined and the construction and operation of the 12-MeV linear accelerator at Hattingen is described. The radiation protection measures necessary are considered. The basic studies of Mueller and Weeber are considered and the varying effects of the input parameters are illustrated. The optimum results to be expected from test devices with high output are discussed. (tr-auth)

52246 (DESY-70/34) PARTICLE REBUNCHING BY AN ADDITIONAL LOWER FREQUENCY RF SYSTEM IN ELECTRON STORAGE RINGS. Kohaupt, R. D. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Aug 1970. 29p. Dep. NTIS (U. S. Sales Only).

In the energy region where the storage ring luminosity is limited by the available power and the natural beam size it is proportional to the population number. The change of the population number with an additional rf system of lower frequency is discussed. The re-

bunching mechanism is investigated with respect to beam lifetime and efficiency. (auth)

52247 (IAE-1737) THICK TARGETS FOR OBTAINING NEUTRONS IN LINEAR ELECTRON ACCELERATORS. Gerasimov, V. F.; Knizhnikov, Yu. N. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1968. 27p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The neutron distribution, the heat evolution and the spacial distribution of photons are important factors in the use of thick targets. At present there is a scarcity of experimental and design data which could be used in designing targets for electron accelerators at high beam power. Semi-empirical calculations were carried out to obtain estimates on the total neutron yield and heat distribution as a function of target thickness and spacial distribution of bremsstrahlung radiation in Al, Mo, W, Pb, U, and Pu. The activity induced in copper foils as a result of the Cu-65 (gamma,n) Cu-64 reaction was used to determine the neutron yield in substances irradiated with 26 MeV electrons. Thin copper foils were placed between layers of the substance to be irradiated. In order to obtain a maximum number of neutrons, a uranium or plutonium target 2 to 2.5 cm long can be used at a beam power of 50 to 100 kilowatts. Since the heat evolved is >1 kilowatt/cm^3, it would be desirable to add light metals (Al or Be) as diluents or as covering materials in a water-cooled target. (TTT).

52248 (JINR-P9-5208) IMPROVEMENT OF THE EXTENSION SYSTEM OF THE JINR SYNCHROCYCLOTRON BEAM. Danilov, V. I.; Enchevich, L. B.; Rozanov, E. I.; Smirnov, V. I.; Shestov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1970. 14p. (In Russian). Dep. CFSTI (U. S. Sales Only).

A thyristor trigger is described exciting in the coils of magnetic extension of a synchrocyclotron beam, a sawtooth pulse having rise time 6.5 ms, amplitude 130 A and frequency 110-115 Hz. Duration of the extracted extended beam of mesons is 70% of the acceleration cycle, while intensity equals 55% of the usual extraction without extension. (auth)

52249 (LA-4514) MEDIUM-ENERGY PHYSICS PROGRAM. Quarterly Status Report for the Period Ending July 31, 1970. (Los Alamos Scientific Lab., N. Mex.). Sep 1970. Contract W-7405-eng-36. 43p. Dep. NTIS.

Progress is reported on the development of accelerator structure, rf power systems, accelerator control and instrumentation, accelerator physics, and the experimental area. The status of LAMPF scheduling and facility construction is outlined, and meetings of the LAMPF users group are reported. Also, progress in experimental physics research is outlined, including the proton-Compton experiment, the pion absorption experiment, and the development of multiwire proportional counters. (W.H.K.)

52250 (LNF-70/33) NUMERICAL CALCULATIONS ON THE SMALL ANGLE SCATTERING LUMINOSITY MONITOR USED AT ADONE. Note No. 485. Dehne, H. C.; Preger, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 13 Jul 1970. 38p. Dep. NTIS (U. S. Sales Only).

Numerical calculations of the dependence of the small angle e^+e^- scattering cross section on the source displacements are presented. The results of these calculations can be used to determine the sensitivity of the luminosity measurement to displacements of the source and to check the internal consistency of the measurements. The counter telescopes, displacements of the interaction region, simultaneous displacements, internal consistency, and counters positioning are discussed. (W.H.K.)

52251 (LYCEN-7004) DESIGN AND DEVELOPMENT OF ACHROMATIC OPTICS FOR THE LYON SYNCHROCYCLOTRON. Reboulet, Gerard (Lyon Univ. (France). Institut de Physique Nucleaire. Lyon Univ. (France)). Feb 1970. 51p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

An attempt was made to develop a high resolution analysis system for accelerator beams. A sensible improvement in the intensity of the beam at the target was obtained by using two conveniently placed magnetic analyzers. Thus the resolution was increased and effects arising from the target thickness were compensated by appropriately orientating the target with respect to the incident beam. The analysis systems adapted to the Lyon synchrocyclotron are studied. Their development and the tests used are explained. (France)

52252 (LYCEN-7027) DEVELOPMENT OF ION SOURCES FOR PARTICLE ACCELERATION BY VARIOUS INDIRECT METHODS. Tauth, Theodore (Lyon Univ. (France). Institut de Physique Nucleaire). May 1970. 72p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Univ. of Lyon, France.

Ion sources were developed and constructed for particle acceleration by various indirect methods: heavy ions, associated particles, negative ions, and particles of given Z/A values. According to the type of accelerator, different axial or radial variants were developed. In order to understand the ion formation processes, the physics of the arc sources was studied and various quantitative relations between the most important parameters of the discharge obtained. The agreement between the calculations and experimental results was satisfactory. Phenomena such as cathode oscillation, which influence the discharge zone were studied. The behavior of the associated particles and the low binding energy ions during the acceleration were analyzed and loss mechanisms suggested. The relations that allow the different accelerator parameters to be obtained were studied. Several aspects of a charge exchange accelerator were dealt with in detail. A method for calculating the trajectories of an ion beam extracted from a source, passing through a transport system, was described. The sources studied (producing H^-, He_4^+ and H_3^+ ions) had excellent yields. (auth) (France)

52253 (LYCEN-7053) VISUAL DISPLAY UNIT CONNECTED TO AN ON LINE COMPUTER USED IN NUCLEAR PHYSICS. Gimond, Guy (Lyon Univ. (France). Institut de Physique Nucleaire. Lyon Univ. (France)). 10 Jul 1970. 66p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The visual display of nuclear physics spectra on a cathode screen was studied to control experiments and allow dialogue between experimenter and computer by an intermediate visual unit when used at the information input. The following points were treated: the use of a computer for acquiring and treating nuclear physics data, the analysis of problems of visual display on a cathode screen, the presentation of a visual display unit connected to a small computer connected to the Lyon synchrocyclotron, a description of the unit, its language, the associated electronics and the programs which were used. (France)

52254 (ORNL-4599) CALCULATION OF THE LONG-LIVED INDUCED ACTIVITY IN THE SOIL AROUND HIGH-ENERGY ACCELERATOR TARGET AREAS. II. Gabriel, T. A.; Alsmiller, R. G. Jr.; Barish, J. (Oak Ridge National Lab., Tenn.). Oct 1970. Contract W-7405-eng-26. 27p. Dep. CFSTI.

Nucleon-meson cascade calculations have been carried out and estimates of the induced activity in the soil surrounding high-energy accelerator target areas have been obtained. Results are presented for 200- and 500-GeV protons incident on a lead target and for 50-GeV protons incident on a beryllium target. The calculated results include the induced activity as a function of position and time after the proton beam is turned off for an assumed irradiation time of 25 years. In order to carry out the calculations, many "ad hoc" assumptions have been made, and therefore the results must be considered to be very approximate. (auth)

52255 (RPP/N-21) ELECTRONICALLY CONTROLLED HYDRAULIC SYSTEMS FOR EXTRACTOR MAGNETS. Cloke, V. C. (Rutherford High Energy Lab., Chilton (England)). [1970]. 14p. (CONF-700908-2). Dep. CFSTI (U. S. Sales Only).

From 2nd National Conference on Particle Accelerators, Moscow, USSR.

The mechanisms used for the Piccioni extraction systems in general use on Nimrod are described. The large aperture of this accelerator dictates the use of large extraction systems using magnets of around 1000 Kg in weight. These magnets are required to be plunged through 50 cm in approximately 0.5 S at a repetition rate of 22/min. The time between injection platform and fast spill is about 800 ms for normal 7 GeV running, however, a required dwell time of 200 ms after injection and 50 ms before spill effectively reduces the extractor magnet stroke time to 550 ms. At energies below 7 GeV, this time could be reduced to 400 ms. Speeds of this order require a peak power of some 150 hp (114 KW), which is transmitted through a hydraulic actuating mechanism. The oil flow to the hydraulic ram has a maximum of 5 l/s at a peak pressure of 3000 lb/in^2 (206 bar) and at the time of construction no servo valve was available to handle this flow level. Consequently, the hydraulic power was supplied by a variable delivery swash pump. (W.H.K.)

52256 (SLAC-PUB-797) VACUUM SYSTEM FOR STANFORD STORAGE RING, SPEAR. Cummings, U.; Dean, N.; Johnson, F.; Jurow, J.; Voss, J. (Stanford Linear Accelerator Center, Calif.). Sep 1970. Contract AT(04-5)-515. 15p. (CONF-701011-1). Dep. NTIS.

From 17th National Vacuum Symposium, Washington, D. C.

Due to its unusual geometry and gas load, the SPEAR vacuum system incorporates several unique design features. The system consists of an aluminum chamber in the form of a 200-foot diameter ring which must achieve a pressure in the 10^{-9} torr range with a large gas load due to synchrotron radiation induced desorption. Since the system is conductance limited, it was necessary to develop distributed sputter ion pumps located within the chamber proper. A large number of aluminum-to-stainless steel interfaces required the development and testing of various flange arrangements which would withstand a bakeout to 200°C. (auth)

52257 (SLAC-PUB-804) HIGH POWER KLYSTRON DEVELOPMENT AT THE STANFORD LINEAR ACCELERATOR CENTER. Stringall, R. L.; Lebacqz, J. V. (Stanford Linear Accelerator Center, Calif.). Sep 1970. 7p. (CONF-700914-1). Dep. CFSTI.

From 8th International Conference on Microwave and Optical Generation and Amplification, Amsterdam, The Netherlands.

A brief review of the Stanford klystron development, design and performance, and computer analysis is given. The program was initiated to increase the peak power output of the klystrons so that the beam energy is increased without increasing the number of klystron sockets. Considering power supply limitations and klystron life, an objective peak power output of 34 MW at a beam voltage of 270 kV was established. The end result should be a beam energy of approximately 25 GeV. Also, life experiences of all klystrons used at the accelerator center are reviewed. (W.H.K.)

52258 (TID-25473(Vol.1)) PARTICLE BEAMS, 1969 Summer Study. Roberts, Arthur (ed.) (National Accelerator Lab., Batavia, Ill.). 472p. Dep. CFSTI.

Separate abstracts were prepared for each of the 60 papers presented. (W.H.K.)

For abstracts of individual papers see: 51905, 51923–51925, 52004, and 52259–52313.

52259 (TID-25473(Vol.1), pp 1-2) EXTERNAL PROTON BEAM. Mobley, Richard (National Accelerator Lab., Batavia, Ill.).

Some considerations on the external beam line are given which are pertinent to targeting for secondary beams. (auth)

52260 (TID-25473(Vol.1), pp 3-6) SMALL-EMITTANCE, HIGH-INTENSITY PROTON BEAM. Maschke, A. (National Accelerator Lab., Batavia, Ill.).

The design of a collimated proton beam of intensity 10^{-3} of the external proton beam is considered. (auth)

52261 (TID-25473(Vol.1), pp 7-11) USE OF A DIFFRACTED PROTON BEAM TO PRODUCE TERTIARY BEAMS. Rubinstein, R. (Brookhaven National Lab., Upton, N. Y.).

The use of tertiary beams produced from a diffracted proton beam is discussed. It is concluded that in many cases such beams have several advantages—particularly, though not exclusively, for lower momenta. The flexibility inherent in a diffracted proton beam station makes it especially useful in the early days of the accelerator. (auth)

52262 (TID-25473(Vol.1), pp 13-17) COMMENTS ON AREAS FOR EXPERIMENTS WITH THE PRIMARY EXTRACTED PROTON BEAM. Terwilliger, Kent M. (Michigan Univ., Ann Arbor); Mobley, Richard M. (National Accelerator Lab., Batavia, Ill.).

This report emphasizes the necessity of having a target area where experiments can be done directly with the full-intensity extracted proton beam and the necessity that an area be available for simple production experiments at machine turn-on. Comments and recommendations are made on some of the possible types of areas for these purposes. (auth)

52263 (TID-25473(Vol.1), pp 19-25) POLARIZED PROTONS AT THE 200-GeV ACCELERATOR. Overseth, O. E. (Michigan Univ., Ann Arbor).

We show how beams of high-energy protons with intensities $\sim 10^5$ protons per pulse and with transverse and longitudinal polarization each as high as 50% can be produced from Λ^0 decay. The transverse and longitudinal components are variable, and can be calculated from the kinematics of Λ^0. Beams of similarly polarized antiprotons should also be available with intensities $\sim 10^3$ per pulse. (auth)

52264 (TID-25473(Vol.1), pp 27-31) A POLARIZED PROTON BEAM FROM Λ^0 DECAY. Overseth, O. E. (Michigan Univ., Ann Arbor); Sandweiss, J. (Yale Univ., New Haven, Conn.).

We investigate the possibilities of providing beams of polarized protons at the 200-GeV accelerator. Three possibilities are considered: 1) direct acceleration of polarized protons, 2) polarization from elastic scattering, and 3) polarized protons from hyperon decay. In particular, the problem of polarization resulting from hyperon decay is treated in some detail. Beams of high-energy protons with intensities $\sim 10^5$ per pulse and 50% polarization appear feasible from Λ^0 decay. With machine modifications direct acceleration of polarized protons appears possible resulting in intensities 10^2 higher than in beams from hyperon decay. (auth)

52265 (TID-25473(Vol.1), pp 33-9) SECONDARY TARGET STATION NO. 2. Barish, B. C. (California Inst. of Tech., Pasadena); Bingham, G. (National Accelerator Lab., Batavia, Ill.); Berley, D.; (and others) (Brookhaven National Lab., Upton, N. Y.).

The layout of a set of beams is described. The yields, beam characteristics, and some of the motivations that lead to this proposal are discussed. (auth)

52266 (TID-25473(Vol.1), pp 41-53) HIGH-QUALITY UNSEPARATED BEAMS. Reeder, Don (Wisconsin Univ., Madison); MacLachlan, J. (National Accelerator Lab., Batavia, Ill.).

This report contains a general discussion of design philosophy and a specific application to a 200 GeV/c and 120 GeV/c unseparated beam. (auth)

52267 (TID-25473(Vol.1), pp 55-62) 3.5 MRAD HIGH-INTENSITY BEAM. Barish, B. C. (California Inst. of Tech., Pasadena).

A very high-intensity 3.5 mrad beam is proposed for End Station 2. The beam has very large acceptance ($\Delta\Omega$ = 3.8 μsr, $\Delta p/p \geq 10\%$) giving yields adequate to produce useful tertiary beams. The beam has been designed so that it could be used to produce a hyperon beam, electron beam, or a clean K_L^0 beam. The possibility also exists of using the high flux of π-mesons ($>10^8$/sec) directly for certain experiments. Two experimental areas in series are proposed. (auth)

52268 (TID-25473(Vol.1), pp 63-73) HYPERON BEAM IN TARGET-AREA 2. Berley, D. (Brookhaven National Lab., Upton, N. Y.); Bingham, G. (National Accelerator Lab., Batavia, Ill.); Conforto, G. (Chicago Univ., Ill.).

Two possibilities for a relatively simple negative hyperon beam to be installed in area 2 are discussed. A survey experiment using a DISC Cherenkov counter is proposed. (auth)

52269 (TID-25473(Vol.1), pp 75-88) NAL GENERAL-PURPOSE TARGET STATION. Wenzel, W. A. (California Univ., Livermore. Lawrence Radiation Lab.).

The general-purpose target station proposed by Frauenfelder and Wenzel has been considered in additional detail. The characteristics are: (1) Four beam channels on each side of the beam provide nominal momenta of ±15, ±30, ±60, and ±120 GeV/c. Several neutral beams are available too. (2) Use of a 2-GeV/c front dispersing magnet provides 0-degree beams into each charged-particle channel. (3) With a 20-kG front dispersing magnet, a 10-inch diameter quadrupole system is needed to contain particles with $p_\perp \leq 0.35$ GeV/c. A stronger magnet would permit some reduction in aperture. (4) Use of a cylindrical front dispersing magnet provides the possibility of adding two lower momentum beams on each side. (5) A beam chamber containing the front collimators for all channels would be removable as a unit. (6) Following the front collimator, each secondary channel contains a small septum correcting magnet, a remotely adjustable (horizontally) collimator, a quadrupole doublet (or triplet), and a dispersing dipole. (7) For each channel a focus at the outer edge of the shielding wall (30 ft from the beam line) can be obtained for up to twice the nominal channel momentum. (8) The momentum spectrum of flux available has a fwhm of ⅓ to ½ the nominal channel momentum. (9) The quality of the beams is good, so that momentum widths less than the pion mass can be effectively collimated. Mass separation should be straightforward. (10) About ⅓ of the kaons decay inside the shielding wall. (11) By rearranging a channel to eliminate dispersion, a superintense beam can be focused on a target within the shielding wall. This beam can be used to produce tertiary beams. (12) Some special-purpose experiments can be done without rearrangement, through detailed control of the front dispersing magnet. (13) The amount of modular shielding provided should depend on the time scale that can be tolerated for presumably infrequent beam changes and repairs. (auth)

52270 (TID-25473(Vol.1), pp 89-95) SHORT HIGH-INTENSITY BEAM. Rubinstein, R. (Brookhaven National Lab., Upton, N. Y.).

A short (100 m) high-intensity beam has been designed for 150 GeV/c pions, which could easily be made into a diffracted proton beam. (auth)

52271 (TID-25473(Vol.1), pp 97-100) DEUTERON BEAMS AT THE 200-GeV ACCELERATOR. Overseth, O. E. (Michigan Univ., Ann Arbor).

The available experimental information on production of high-

energy deuterons is examined for the prospects of deuteron beams at the 200-BeV accelerator. The surprisingly copious production of high-momentum deuterons observed in collisions of 25-BeV protons with other protons or with complex nuclei indicates that deuteron beams should be available with intensities roughly of the order of antiproton beam fluxes. (auth)

52272 (TID-25473(Vol.1), pp 101-5) DESIGN CONCEPTS FOR SPECIAL SECONDARY PARTICLE BEAMS AND TARGET AREAS AT NAL. Read, A. L. (National Accelerator Lab., Batavia, Ill.).

This report describes a preliminary study by the 1969 Summer Study Group "G" of possible design concepts for special secondary particle beams which might be installed at NAL experimental-area #3. (auth)

52273 (TID-25473(Vol.1), pp 107-8) COMMENTS ON THE HEIGHT OF SECONDARY BEAMS. Rubinstein, R. (Brookhaven National Lab., Upton, N. Y.).

The height of counter/spark chamber beams above the experimental-hall floor is discussed, and it is concluded that the optimum height is between 6-½ ft and 8 ft. (auth)

52274 (TID-25473(Vol.1), pp 109-11) COMMENTS ON THE USE OF SUPERCONDUCTING BEAM TRANSPORT MAGNETS. MacLachlan, J. (National Accelerator Lab., Batavia, Ill.).

Comments on quadrupole aperture, magnet dimensions, and magnet heating by secondary beams are made in the particular context of the plans for target-area 2 developed in this summer study. The qualitative effect on these plans of the choice between superferric and conventional bending magnets appears small. (auth)

52275 (TID-25473(Vol.1), pp 113-17) RF SEPARATED BEAM OF LONG DUTY CYCLE (20 TO 50 GeV/c). Foelsche, H. (Brookhaven National Lab., Upton, N. Y.).

A separated beam of K mesons (20-40 GeV/c momentum) and of antiprotons (20-47 BeV/c) is discussed. This beam, designed for target-area 2, incorporates normally conducting rf separators operating at a frequency of 8 GHz (X-band) at a duty cycle of 33% as required for counter/spark-chamber detectors. Superconducting separators would be preferable but they may not be available in 1972, and a bruteforce solution exists for this beam. At a momentum bite of only 0.1% the available K-meson and antiproton intensities are so large that a detector system limited to 10^6 beam particles per second could not handle them unless the separator is employed to remove the π meson or proton background. (auth)

52276 (TID-25473(Vol.1), pp 119-24) NORMAL RF SEPARATOR WITH 33 PERCENT DUTY CYCLE. Foelsche, H. (Brookhaven National Lab., Upton, N. Y.).

The paper gives an analysis of the parameters of an rf separator of long duty cycle employing normally conducting copper structures, operating at a frequency of 8 GHz. A comparison with an equivalent superconducting device is given. It is concluded that the normal spearator is a technically feasible option. It would, however, become obsolete if and when the superconducting equivalent becomes operational at these high operating frequencies. The normal device would be quite useful in the energy region around 30 GeV as a stopgap solution in case the superconducting one gets delayed. (auth)

52277 (TID-25473(Vol.1), pp 125-31) USE OF DIELECTRIC LOADED WAVEGUIDES FOR RF PARTICLE SEPARATION AT NAL. Sandweiss, J. (Yale Univ., New Haven, Conn.).

It has been shown by Dawson and Kustom that a transverse deflecting mode can be propagated down a dielectric-loaded smooth-bore waveguide. This paper investigates the application of such deflectors to NAL beams. It is pointed out that substantial power economies appear feasible and that such deflectors may well allow CW operation with presently available power tubes. (auth)

52278 (TID-25473(Vol.1), pp 133-41) SKETCH OF A VERY HIGH FLUX SEPARATED ANTIPROTON BEAM. Murphy, C. T. (Carnegie-Mellon Univ., Pittsburgh, Pa.).

The design of a separated antiproton beam for up to 50 GeV/c is sketched. It utilizes the dielectric-loaded waveguide separator discussed by Sandweiss. The beam has a momentum bite of ±1%, a solid angle of 5×10^{-5} sr, and yields about 5×10^6 $\bar{p}$/pulse at 20 GeV/c and 5×10^5 $\bar{p}$/pulse at 50 GeV/c. An expensive AG channel of quadrupoles is required to hold the beam together in the separator. (auth)

52279 (TID-25473(Vol.1), pp 143-5) VERY LOW ENERGY PARTIALLY SEPARATED K BEAMS. Rubinstein, R. (Brookhaven National Lab., Upton, N. Y.).

Methods for producing very low energy K beams are discussed. (auth)

52280 (TID-25473(Vol.1), pp 147-51) RF-SEPARATED BEAM FOR A BUBBLE CHAMBER IN AREA 1 (15 TO 45 GeV). Berley, D.; Foelsche, H. (Brookhaven National Lab., Upton, N. Y.).

We have made a conceptual design of a low-energy rf-separated hadron beam for a bubble chamber of intermediate size, which would operate in area 1 and require only low proton intensity. It uses the transmission target proposed with the muon channel. No attempt was made to make the beam attractive for counters. Instead the emphasis was on low intensity use compatible with the muon experiments. (auth)

52281 (TID-25473(Vol.1), pp 153-61) ELECTRON-PHOTON BEAM AT NAL. Diebold, R. (Argonne National Lab., Ill.); Hand, L. (Cornell Univ., Ithaca, N. Y.).

The modification of one of the small-angle, high-intensity beams in experimental-area 2, to serve as an electron-photon beam, is proposed and discussed. (auth)

52282 (TID-25473(Vol.1), pp 163-5) BREMSSTRAHLUNG TAGGING OF HIGH-ENERGY ELECTRONS. Heusch, C. A. (California Inst. of Tech., Pasadena).

A brief survey is given of means in which electrons in the 100-GeV region can be identified. It is pointed out that in addition to other established techniques, the tagging of electrons by bremsstrahlung quanta may provide an excellent signature. The inefficiencies encountered in the bremsstrahlung tagging of photons are not found here. (auth)

52283 (TID-25473(Vol.1), pp 167-71) MAXIMUM INTENSITY ELECTRON AND PHOTON BEAMS FROM PHOTON ACCELERATORS. Heusch, Clemens A. (California Inst. of Tech., Pasadena).

Existing beam designs for electron and photon beams start from the requirement of beam purity and are limited in obtainable intensity. It is pointed out that, while the primary photon beam emerging from a nucleon-nucleon collision target is not useful for experimental purposes, a primary electron beam can under certain circumstances present advantages. While it is true that in general conversion of photons from π^0 decay in an external radiator is preferable, this applies mainly to the upper end of the spectrum. Internal conversion allows for a larger conversion rate and makes the containment of a larger solid angle feasible. The main advantage of external conversion, the relative freedom from hadronic backgrounds, may not be so important in view of new separating techniques. Intensity gains on the order of a factor of 10 appear possible. (auth)

52284 (TID-25473(Vol.1), pp 173-85) SHORT-LIVED NEUTRAL BEAM. March, R. H. (Wisconsin Univ., Madison).

A neutral-beam channel to permit detectors within 10 meters of the target is discussed. Such a beam can be used to study Λ^0 and Ξ^0 decays and K^0 decays in the region of maximum $K_S^0 - K_L^0$ interference. The beam combines sweep magnet and hadronic shield into a single device for compactness. Reasonable fluxes can be obtained with proton beams of 10^9 to 10^{10} per pulse; thus, the beam need not have access to a primary proton line. (auth)

52285 (TID-25473(Vol.1), pp 187-92) A "NEUTRON-FREE" K_L^0 BEAM. Zdanis, R. A. (Johns Hopkins Univ., Baltimore, Md.).

The production of a "neutron-free" K_L^0 beam from an unseparated π, K beam is described. The intensity of such a beam should be a 3×10^{-5}/pion with a ±10-mrad divergence. The energy spectrum of the resultant K_L^0 is strongly peaked at the incident beam energy. (auth)

52286 (TID-25473(Vol.1), pp 193-4) LONG-LIVED NEUTRAL BEAMS. Zdanis, R. A. (Johns Hopkins Univ., Baltimore, Md.).

Neutron and K_L^0 beams in Target Station 2 are discussed. Provision is made for various intensities, energy spectra, and purities. (auth)

52287 (TID-25473(Vol.1), pp 195-201) A NEUTRON BEAM FOR NAL. Jones, Lawrence W. (Michigan Univ., Ann Arbor).

A possible neutron beam at NAL, its desired characteristics, and some experiments for it are described. (auth)

52288 (TID-25473(Vol.1), pp 203-11) NEUTRAL BEAMS OF VARIABLE COMPOSITION. Heusch, C. A. (California Inst. of Tech., Pasadena).

This is a plea to install steering magnets in the proton beam line upstream of the EPB target which is used for the production of neutral secondaries. It is argued that, while it is possible to generate high-purity neutral beams as tertiaries, and fairly high-intensity neutral beams in the proposed 3.5 mrad beam of the projected experimental-area 2, many experiments will depend on the variability of intensity, spectral composition, and relative particle

yield which can be provided only by the possibility of using a given beam layout at angles variable with respect to the incident primary proton beam. In addition, we suggest that the neutral beam have a sweeping magnet as close to the EPB target as possible; this maximizes the flux of neutrals, but makes coexistence with many other beams projected for area 2 impossible. (auth)

52289 (TID-25473(Vol.1), pp 213-16) FRONT END OF NEUTRAL BEAM FACILITY. Heusch, C. A. (California Inst. of Tech., Pasadena).

In an attempt to accomodate a neutral beam facility compatibly with other beams in one end station of the 200-GeV accelerator, a particular design for its front end is suggested. It provides for interchangeable use of three different channels incorporated in one self-contained "beam plug" to be moved vertically. Two channels serve neutral beams, one a charged beam. (auth)

52290 (TID-25473(Vol.1), pp 217-49) NEUTRINO BEAM DESIGN. Kang, Y. W.; Nezrick, F. A. (National Accelerator Lab., Batavia, Ill.).

The important parameters of neutrino beams have been studied at NAL to develop a conceptual neutrino beam design. It has been found that a neutrino beam with a decay length of 600 m, a shielding thickness of 300 m, and a decay tunnel radius of 0.75 m is quite appropriate for either 200-BeV or 400-BeV operation of the NAL proton synchrotron. It appears useful to fill the decay tunnel with bags of He or operate in vacuum to substantially reduce the number of secondary beam (π or K) collisions in the decay tunnel. With a focusing system of two elements located inside target station T1, one elastic event in every four pictures of the 25 ft deuterium-filled bubble chamber can be obtained. (auth)

52291 (TID-25473(Vol.1), pp 251-7) FLEXIBLE TARGET STATION IN AREA 1. Berley, D. (Brookhaven National Lab., Upton, N. Y.).

A target station is described which allows the production in experimental-area 1 of not only a wide-band neutrino beam but also a muon/tagged neutrino beam and a rf-separated bubble-chamber beam of low to moderate energies. (auth)

52292 (TID-25473(Vol.1), pp 259-63) SECONDARY BEAM FOR MUONS AND NEUTRINOS FOR AREA 1. Berley, D. (Brookhaven National Lab., Upton, N. Y.); Hand, L. (Cornell Univ., Ithaca, N. Y.).

The characteristics of a beam which will permit a thin transmission target (or a thick target) to be placed upstream of the horn target in area 1 are outlined. Hadrons produced at 0° are collected into a transport system for the production of muons. The protons which have not interacted in the transmission target are refocused onto a second target. (auth)

52293 (TID-25473(Vol.1), pp 265-72) LONG-SPILL MUON AND NEUTRINO BEAMS IN AREA I. Kirk, T. (Harvard Univ., Boston, Mass.).

A modification is described which permits the addition of slow spill muon and neutrino beams to the planned pulsed horn neutrino beam in Area 1. The new beams share the decay tunnel and muon shield presently planned. The modifications to the pulsed beam operation are negligible. (auth)

52294 (TID-25473(Vol.1), pp 273-8) NEUTRINOS AND MUONS IN AREA 1. Hand, L. N. (Cornell Univ., Ithaca, N. Y.); Mann, A. K. (Pennsylvania Univ., Philadelphia).

Possible expansion of experimental-area 1 to obtain greater utility and flexibility is considered. Neutrino experiments might be performed with spark chambers in that area near the anticipated location of the 25-foot bubble chamber using either a neutrino beam with pulsed magnetic horn focusing or a beam with dc focusing elements generated in a target upstream of the horn target. Muon experiments might be performed with a narrow band ($\Delta p/p - 0.1$) muon beam obtained from either a separate target or the same target as the dc focused neutrino beam. A muon channel separate from the highest intensity neutrino beam channel will make available a second high-energy neutrino beam capable of being tagged. (auth)

52295 (TID-25473(Vol.1), pp 279-95) A STUDY OF 40 TO 90 GeV NEUTRINO INTERACTIONS USING A TAGGED NEUTRINO BEAM. Hand, L. N. (Cornell Univ., Ithaca, N. Y.).

A discussion of the significance of inelastic neutrino reactions is followed by a proposal to study the energy dependence of the total cross section and $d\sigma/dq^2$ using a beam of "tagged" neutrinos. The muon energy from K decay is determined to measure the neutrino energy. Reaction rates of ≈350 interactions per day can be obtained. (auth)

52296 (TID-25473(Vol.1), pp 297-303) POSSIBLE LAYOUTS FOR A MUON-LONG SPILL NEUTRINO (μ-ν_μ) BEAM. Teng, Lee C. (National Accelerator Lab., Batavia, Ill.).

Possible locations and layouts for a muon and long-spill neutrino beam were studied. If a high-momentum long-spill separated beam for counter and spark-chamber experiments is planned for beam 1 it is advantageous to install the muon-neutrino beam as a branch of beam 1 to share the experimental area with the separated beam. Otherwise it would be simpler to install the muon-neutrino beam on beam 3. (auth)

52297 (TID-25473(Vol.1), pp 305-14) A PROPOSAL FOR A TWO-TARGET NEUTRINO FACILITY FOR EXPERIMENTAL-AREA E1, PROVIDING HIGH- AND LOW-ENERGY NEUTRINOS AND MUONS. Meyer, S. L. (Northwestern Univ., Evanston, Ill.); Toohig, T. (Brookhaven National Lab., Upton, N. Y.).

We present an argument for a two-target facility for experimental-area E1. Although we have not optimized the parameters of the beam configuration, we believe that the number and importance of the potential advantages of this idea are such as to warrant it being thoroughly explored. Among the advantages which we see arising from the concept are the following: flexibility of neutrino physics capability, optimization of neutrino flux, specificity of neutrino beam spectrum, efficient transformation to 400-GeV operation, and possible overall cost savings on the entire experimental facility. (auth)

52298 (TID-25473(Vol.1), pp 315-28) A LOW ENERGY NEUTRINO BEAM CONFIGURATION FOR AREA 1 BASED ON THE TWO-TARGET CONCEPT. Meyer, S. L. (Northwestern Univ., Evanston, Ill.); Toohig, T. (Brookhaven National Lab., Upton, N. Y.).

We expand upon our suggestion that there be two neutrino targets in Area 1. We show that it is possible to obtain substantial fluxes in the lowest energy region ($E_\nu \leq 5$ GeV) and in the mid-region of $5 \leq E_\nu \leq 30$ GeV by running $E_{proton} < 200$ GeV and choosing the shield appropriately, and by optimizing the decay length. We suggest a mode of operation which is compatible with a long spill for counter beams, on other targets, but we do not preclude running the machine in a non-compatible manner at 70 or 100 GeV utilizing the resultant increased repetition rate to increase the speed of data acquisition of low energy events. (auth)

52299 (TID-25473(Vol.1), pp 329-32) THE DESIGN OF A LOW ENERGY NEUTRINO BEAM AT NAL. Palmer, R. B. (Brookhaven National Lab., Upton, N. Y.).

For form-factor determination, a neutrino beam optimized for $E_\nu = 0.5$ to 2.5 GeV is required. The length of such a beam is estimated to be ~30 meters. A 10-meter uranium shield is proposed. A method is presented that would allow, without inevitable μ background, a 200-GeV proton beam to produce a higher multiplicity of the required energy π's by nuclear cascade. The multiplicity is estimated to be ~5 and this is found to be no more than the repetition rate gain if instead 20-GeV protons are used in a more conventional beam. The latter is recommended. (auth)

52300 (TID-25473(Vol.1), pp 333-42) NOTE ON NEUTRINO BEAM DESIGN. Frisch, D. H. (Massachusetts Inst. of Tech., Cambridge).

Several different designs for neutrino beams are considered in an attempt to minimize shielding and maximize intensity over as wide an energy range as possible. Both one- and two-target systems and magnetic muon sweeping systems are considered. (auth)

52301 (TID-25473(Vol.1), pp 353-9) SOME SIMPLE MUON BEAMS. Christenson, J. H. (Columbia Univ., New York).

A few trivial muon beams are discussed. With a single quadrupole lens, one may obtain 10^9 $\mu^+/10^{13}$ interacting protons at a muon momentum of 100 ± 5 GeV/c within a 10 cm diameter area at the experiment, with an angular divergence of 1 mrad. (auth)

52302 (TID-25473(Vol.1), pp 361-5) MUON BEAMS COMPARED. Christenson, J. H. (Columbia Univ., New York).

A number of muon beams are compared, ranging in size from a 100-meter beam using 2 quadrupoles to one which is a kilometer long requiring 22 quadrupoles. (auth)

52303 (TID-25473(Vol.1), pp 367-73) NEUTRINO SPECTRUM DETERMINATION FROM MUON FLUX MEASUREMENTS. Wachsmuth, H. W. (Wisconsin Univ., Madison. European Organization for Nuclear Research, Geneva (Switzerland)).

The muon flux measured in the neutrino shielding during a neutrino experiment can be used to determine the neutrino spectrum. This method has been applied for the CERN 1967 neutrino experiments. In this note a crude extension to 200-GeV proton energy is given and improvements to be done are pointed out. (auth)

52304 (TID-25473(Vol.1), pp 375-9) THE DISADVANTAGES IN OPERATING THE NAL NEUTRINO BEAM AT LESS THAN THE FULL ACCELERATOR ENERGY. Nezrick, F. A. (National Accelerator Lab., Batavia, Ill.).

The suggestion of producing the neutrino beam at NAL at less than the full accelerator energy has been studied. By operating the accelerator at 150 and 100 GeV at a faster repetition rate, the total number of pions produced per second above 5 GeV is comparable to that produced at 200 GeV. However, the loss of higher energy pions when the accelerator is operated at the lower energies is significant. The advantages of this operation are that the muon shield becomes less expensive, and the neutrino flux below 4 GeV can be enhanced. Some of the disadvantages of this mode of operation are 1) there is a significant reduction in the neutrino flux above about 4 GeV; 2) there is a lower density of neutrino interactions per accelerator pulse (per bubble-chamber photograph); and 3) the preference of not having a flattop limits the experimental program. (auth)

52305 (TID-25473(Vol.1), pp 381-2) SCALING OF AGS OPERATING EXPERIENCE TO NEUTRINO EXPERIMENTS AT NAL. Toohig, T. (Brookhaven National Lab., Upton, N. Y.).

AGS operating experience of the past several years projected to the time after the conversion indicates the 7-ft bubble chamber will have available $\sim 1 \times 10^{13}$ ppp for continuous operation. A parallel argument points to the possibility of continuous operation of the NAL 25-ft bubble chamber for neutrino physics when the accelerator reaches full intensity. This would seem to be a relevant factor in considering utilization of the 25-ft chamber for strong-interaction physics. (auth)

52306 (TID-25473(Vol.1), pp 383-8) DESIGN OF LONG PULSE MONOPOLE FOCUSING ELEMENTS. Palmer, R. B. (Brookhaven National Lab., Upton, N. Y.).

Three monopole designs are considered. It is concluded that a) conventional pulsed horns or fingers can be made to operate for up to 10 msec; b) a dc lithium magnet is theoretically possible but requires technical development; and c) a new design of dc monopole (the FISH) is both possible and practical and could be used in a wide-band system for neutrino beams. (auth)

52307 (TID-25473(Vol.1), pp 389-95) DC HORN FOR VERY HIGH ENERGY SPARK-CHAMBER NEUTRINO EXPERIMENTS. Frisch, D. H. (Massachusetts Inst. of Tech., Cambridge); Kang, Y. W. (National Accelerator Lab., Batavia, Ill.).

The very high energy neutrino spectrum is calculated using a dc Fresnel horn. This horn gives a large fraction of perfect focusing at very high energy. (auth)

52308 (TID-25473(Vol.1), pp 421-4) A POSSIBLE SPECTROMETER FOR ACCOMPLISHING A SECONDARY BEAM SURVEY AT NAL. Billinge, R.; Bieser, E. J.; Juhala, R.; Peters, R.; Read, A. L.; Reardon, P. J.; White, T. O. (National Accelerator Lab., Batavia, Ill.); Cocconi, G. (European Organization for Nuclear Research, Geneva (Switzerland)).

A magnetic spectrometer for accomplishing a secondary particle beam survey ($\pi^{\pm}$, $K^{\pm}$, p, $\bar{p}$) at NAL is briefly described. Cherenkov and scintillation detectors are used. (auth)

52309 (TID-25473(Vol.1), pp 425-41) EXPERIMENTS: BEAM SURVEYS AND SEARCH FOR PARTICLES. Bingham, G. (National Accelerator Lab., Batavia, Ill.); Leipuner, L. (Brookhaven National Lab., Upton, N. Y.); Fowler, E. C. (Duke Univ., Durham, N. C.).

A beam survey that includes a search for quarks and measurement of charged hyperon yields is described. (auth)

52310 (TID-25473(Vol.1), pp 443-7) MAGNETIZED IRON MUON SHIELDS. March, R. H. (Wisconsin Univ., Madison).

A magnetic shield in the form of a gapless "H" magnet of length 6 to 10 meters is proposed as a muon shield as an alternative to a range shield. This particular geometry has the advantage that the high-flux, low-momentum portion of the muon flux is confined to a relatively small angular cone. Applications to both low-intensity beams and neutrino beams are discussed. (auth)

52311 (TID-25473(Vol.1), pp 449-50) PROBLEMS OF MAGNETIC SHIELDING FOR NEUTRINO BEAMS REQUIRING DETAILED STUDY. March, R. H. (Wisconsin Univ., Madison); Frisch, D. H. (Massachusetts Inst. of Tech., Cambridge).

Before the feasibility of magnetic shielding for a neutrino beam can be properly evaluated, certain engineering and physics questions require further study. These problems are outlined. (auth)

52312 (TID-25473(Vol.1), pp 451-63) DESIGN FOR A MUON SHIELD IN THE NEUTRINO BEAM USING MAGNETIZED IRON. Kang, Y. W. (National Accelerator Lab., Batavia, Ill.).

The well-collimated high-energy muon beam at the end of the decay tunnel encourages an introduction of the magnetic deflection in the muon shielding. It is suggested that high-energy muons be deflected by a magnetic field while the remaining muons are ranged out. With this setup we could improve the neutrino flux at the bubble chamber as much as 60% over the present design, at no increase in cost. The present study (at 200 GeV only) indicates that a magnetized iron shield is highly promising and a further study is useful. (auth)

52313 (TID-25473(Vol.1), pp 471-2) NOTE ON AVAILABILITY OF METALLIC URANIUM FOR SHIELDING PURPOSES. Toohig, T. (Brookhaven National Lab., Upton, N. Y.).

The availability and cost of uranium metal for shielding at the NAL Synchrotron are briefly discussed. (W.H.K.)

52314 (TID-25473(Vol.2), pp 281-311) PROPOSAL TO BRING AN INTERIM BUBBLE CHAMBER TO NAL. Gelfand, N. (Chicago Univ., Ill.); Pevsner, A. (Johns Hopkins Univ., Baltimore, Md.); Slattery, P. (Rochester Univ., N. Y.).

The report assumes that the 25-ft bubble chamber will ultimately be built for NAL but that it will not be available for a program of strong-interaction physics until a few years after experimental beams become operational. The possibility of making use of an existing chamber in the interim is discussed. The specific proposal is made to move the 80-in. BNL chamber to NAL and to increase its magnetic field to 30 to 35 kG. (auth)

52315 (TID-25473(Vol.2), pp 313-16) COMPARISON OF STREAMER CHAMBER AND BUBBLE CHAMBER. Ascoli, G. (Illinois Univ., Urbana); Kernan, A. (California Univ., Riverside); Selove, W.; (and others) (Pennsylvania Univ., Philadelphia).

Some features of a large streamer chamber for NAL are examined, and the capabilities of streamer chamber and bubble chamber are compared. While the streamer chamber will not completely replace the large bubble chamber, it appears that for many purposes a large streamer chamber would be a superior instrument. (auth)

52316 (TID-25473(Vol.3), pp 1-5) DISCUSSION OF POSSIBLE USES OF RF BEAM STRUCTURE IN COUNTER EXPERIMENTS AT NAL. Maschke, A. W.; Read, A. L.; Reardon, P. J. (National Accelerator Lab., Batavia, Ill.).

The purpose of this note is to review the arguments concerning possible improvements in the performance of certain counter experiments at NAL which require high-intensity secondary beams ($10^7 - 10^8$ particles/pulse) by utilizing rf structure in the slow extracted proton beam (at frequencies of 50 to 200 Mc/sec), so that a decision can be made relative to the inclusion of this feature in the final design of the flat-top and extraction systems hardware of the 200-GeV accelerator. We therefore discuss possible ways to utilize the rf structure of the main-accelerator proton beam in the performance of counter experiments at NAL. Initially, experiments in which the 53 Mc/sec structure of the accelerator beam might enhance the utilization of high-intensity π, μ, e, and γ beams are discussed. The beam detector systems required, and some difficulties and limitations of the rf structured beam, are considered. On balance, it appears to us that early provision of bunched beam for experiments is not warranted. (auth)

52317 (TID-25473(Vol.3), pp 145-64) NAL ON-LINE COMPUTING FACILITIES. Brenner, A. E. (Harvard Univ., Cambridge, Mass.); Clark, A. R. (California Univ., Livermore, Lawrence Radiation Lab.); Fowler, E. C. (Duke Univ., Durham, N. C.); Jovanovich, J. V. (Manitoba Univ., Winnipeg); Leipuner, L. (Brookhaven National Lab., Upton, N. Y.); MacLachlan, J. (National Accelerator Lab., Batavia, Ill.); Neal, H. A. (Indiana Univ., Bloomington).

The problem of on-line facilities for the experimental program at NAL is studied in some detail. A flexible approach utilizing a small dedicated computer at each experiment with a link to the laboratory's large central facility is recommended. (auth)

52318 (TID-25473(Vol.3), pp 165-76) SPECTROMETER SYSTEM TO STUDY PROCESSES OF THE BARYON EXCHANGE TOPOLOGY. Baker, W. F. (National Accelerator Lab., Batavia, Ill.); Heinz, R. M. (Indiana Univ., Bloomington); White, D. H. (Cornell Univ., Ithaca, N. Y.).

A high-resolution spectrometer system and its application in the study of processes topologically related to baryon exchange is discussed. The design of an experiment on backward pion–nucleon elastic scattering from 10 to 100 BeV/c is considered in detail. (auth)

52319 (TID-25473(Vol.3), pp 177-209) MULTIPARTICLE SPECTROMETER DESIGN FOR NAL. Key, A. W.; Matthews, J. A.; Patel, P. M.; Prentice, J. D.; Vavra, J.; Yoon, T-S (McGill Univ., Montreal (Quebec)).

This paper presents the design of a multiparticle spectrometer useful for the on-line accumulation of data on a variety of high-energy reactions at NAL. In order to be specific, the spectrometer has been designed to provide complete momentum and angular

coverage for the products of the reaction $\pi p \rightarrow p3\pi$ at 100 GeV/c, with accuracies $\delta p \simeq 0.1$ GeV/c and $p\delta\theta \simeq 0.02$ GeV/c. The detectors are assumed to be wire planes with a spatial resolution of 0.2 mm, internal or external to a magnetic field. The momentum analyzer consists of a magnetic field of 20 kG over a volume $8 \times 1.6 \times 0.8$ m^3, followed by a downstream lever arm of length 16 m. Beam requirements, detection of neutrals, and triggering criteria for the specific reaction considered, are briefly discussed. Two appendices give formulae for the calculation of measurement errors inherent in this type of system and an indication of the saving in magnet size resulting from a relaxation of the accuracy requirements. (auth)

52320 (TID-25473(Vol.3), pp 211-19) SMALL-ANGLE ELASTIC AND QUASI-ELASTIC SCATTERING. Diebold, R. (Argonne National Lab., Ill.).

A one-arm spectrometer system, useful for several different experiments, is described. The spectrometer itself looks much like another stage of the beam. Counter hodoscopes are used to measure accurately the momentum and angle of the forward-scattered particle. (auth)

52321 (TID-25473(Vol.3), pp 221-37) FACILITY FOR TWO-BODY ELASTIC SCATTERING REACTIONS. Ritson, D. (Stanford Univ., Calif.).

It is shown that a large-angle, low-momentum, non-focusing spectrometer of ~0.5 steradians, in coincidence with a small-angle, strong-focusing spectrometer, provides a setup which should be able to utilize the full beam intensities available at NAL. With such a facility, measurements could be made with both unpolarized and polarized targets up to about 130 BeV for the u channel and up to about 175 BeV for the t channel. Merits and demerits of strong focusing versus non-focusing high-energy spectrometers are discussed for this application. It is believed that on grounds of physics, engineering, and economy, a strong-focusing spectrometer is clearly superior to a non-focusing spectrometer for high momentum measurements. Preliminary design parameters are given for such a device. (auth)

52322 (TID-25473(Vol.3), pp 239-66) SPECIALIZED MULTIPARTICLE SPECTROMETER. Gittelman, B. (Stanford Linear Accelerator Center, Calif.).

A detection system is described for measuring cross sections for peripheral processes in which the high-momentum forward particle is hadronically stable. (auth)

52323 (TID-25473(Vol.3), pp 267-77) DESIGN CRITERIA FOR A MAGNETIC SPECTROMETER. Osborne, L. S. (Massachusetts Inst. of Tech., Cambridge).

A study is made of analyzing magnets and the accuracies in momentum and angle measurement attainable for various dispositions of the measuring points. We study also the minimization of volume for a given measurement. We conclude: 1. The addition of position measurements beyond a magnet can give up to a factor of five in accuracy compared to measurements wholly in the field. 2. At a fixed solid angle of detection and momentum accuracy it costs from 1.0 to 1.8 times more in magnetic volume to cover the vertex. I conclude that separated magnets for large solid angles are not necessarily economical. 3. In view of point (2) above a magnet that covers a large solid angle (suitable for heavy boson decay) can become a 4π detector by being placed over the vertex and will measure all charged particles down to 0.1 GeV/c. Such a magnet has dimensions $2 \text{ m} \times 2 \text{ m} \times 7.5$ m but is probably overdone. 4. Multiple scattering is becoming important to measuring error. This will place a constraint on scaling down the magnet were a technique found with lower setting error. (auth)

52324 (TID-25473(Vol.3), pp 279-89) ALPHA PROJECT. Ascoli, G. (Illinois Univ., Urbana); Osborne, L. (Massachusetts Inst. of Tech., Cambridge); Selove, W. (Pennsylvania Univ., Philadelphia).

Capabilities and magnet cost are examined for a large magnet used as a single vertex-surrounding analysis device with streamer or wire chambers or similar detector elements. For a magnet of 5 m diameter, 30 kG, comprehensive 4π detection capability can be obtained, together with momentum precision better than 0.1 BeV/c with practical additional downstream measurement. The cost of such a magnet has been estimated to be about $3 million. (auth)

52325 (TID-25473(Vol.3), pp 291) IMPORTANCE OF OPTICAL ACCESS FOR AN ALPHA PROJECT MAGNET. Ascoli, G. (Illinois Univ., Urbana); Selove, W. (Pennsylvania Univ., Philadelphia).

It is suggested that if a large magnet is built for the Alpha Project at the NAL Synchrotron, it be designed so that it can be used with optical access for a streamer chamber or for optical spark chambers. (W.H.K.)

52326 (TID-25473(Vol.3), pp 293-312) HYBRID 4π DETECTION SYSTEM FOR 100-GeV PHOTON PHYSICS AT NAL. Guiragossian, Z. G. T.; Villa, F. (Stanford Linear Accelerator Center, Calif.).

Utilizing an extensive simulation technique, a five-meter superconducting magnet with a streamer chamber is proposed as a NAL facility for 100-GeV photon physics. The system is extended necessarily by wire spark-chamber planes, e/γ detectors, and a π/K Cherenkov counter. A tagged photon beam study is also made with new yield calculations. (auth)

52327 (TID-25473(Vol.3), pp 313-34) INELASTIC MUON SCATTERING USING A VERTEX SPECTROMETER. Anderson, H. L. (Chicago Univ., Ill.).

Inelastic muon scattering at 100 GeV can be measured quite efficiently using a vertex spectrometer. A closed iron magnet with aperture $1.3 \text{ m} \times 1.3 \text{ m} \times 4$ m long is used with liquid hydrogen target and wire chambers operated in the magnetic field. Muon scattering angles in the range 15 mrad $< \theta_\mu <$ 140 mrad are covered over the full 2π polar angle. Rates are 2 per second using a muon beam of 10^7 μ's per one-second-long burst, easily obtained at NAL. The range of q^2 and ν greatly extends that covered in the SLAC electron experiments. Here we measure over the range $1(\text{GeV})^2 < q^2 < 60(\text{GeV})^2$ and $10 \text{ GeV} < \nu < 80$ GeV. The shower particles can be studied in considerable detail. The spectrometer is particularly useful in measuring the forward-going particles carrying high momentum. Thus, the ρ and other bosons expected from the diffractive scattering due to vector dominance ought to be easily identified. The cost of the magnet is estimated to be less than $500,000. Other equipment including the wire chambers and readout are estimated not to exceed $200,000. (auth)

52328 (TID-25473(Vol.3), pp 335-43) PROPOSAL FOR A NEUTRON SPECTROMETER FACILITY AT NAL. Schlein, Peter E. (California Univ., Los Angeles).

A neutron spectrometer facility is proposed which would permit the measurement of $\pi\pi$ and $K\pi$ total cross sections. Time of flight (to $\pm 5\%$) and angular measurements (to $\pm 30-40$ mrad) on the neutron will permit the differential cross section $d^2\sigma/dtdm$ (t is momentum transfer and m is the missing mass above the neutron) to be extrapolated to the pion exchange pole for reactions of the class $Xp \rightarrow n +$ (everything). This neutron spectrometer may later be coupled with an appropriate downstream multi-particle detector to study specific $\pi\pi$ and $K\pi$ inelastic channels. (auth)

52329 (TRI-70-2) CONCEPTUAL DESIGN STUDY OF RF RESONATORS FOR A 500-MeV H^- CYCLOTRON. Grundman, W. A.; Tillson, L. J. P.; Bradley, W. J. F. (Dilworth, Secord, Meagher and Associates Ltd., [Toronto] (Ontario)); Fredriksson, O. K.; Thomas, R. E. (Brobeck (William M.) and Associates, Berkeley, Calif.). May 1970. 86p. Dep. NTIS (U. S. Sales Only).

Issued by TRI-Univ. Meson Facility, Vancouver, British Columbia.

The TRIUMF cyclotron uses quarter wave resonators instead of conventional dees as accelerating electrodes. Proper functioning of the accelerator requires the maintenance of a certain voltage equality along the accelerating gap, which in turn requires that the resonators be structurally rigid and exhibit high mechanical stability. Space limitations within the vacuum tank, as well as preference for a design not incorporating stand-off insulator supports, led to a compromise solution where RF power losses and resonator rigidity are nevertheless acceptable. Five basic shapes for the arms of the resonators were evaluated from the viewpoint of structural rigidity, RF losses and fabrication simplicity. Several model tests carried out by TRIUMF in order to verify the merits of certain design parameters are also described. The report concludes that the use of roll-bond panels (aluminum/silver), reinforced with I-shaped aluminum stiffeners, will result in an acceptable resonator design. (auth)

52330 ROLE OF A DIGITAL PROCESS CONTROL COMPUTER FOR THE LARGE PARTICLE ACCELERATOR OF CERN. Madsen, J. H. B. (CERN, Geneva). Ingenieur (Utrecht); 82: A748-53(25 Sep 1970).

The proton synchrotron is the large proton accelerator of CERN, the European Organization for Nuclear Research. The CERN laboratory is situated at Meyrin, near Geneva, in Switzerland. Twelve European countries participate in its work. The accelerator, a circular machine with a diameter of 200 m, has a complex control system to allow operation from a central control room. To cope with the increasing complexity in the operation and to improve efficiency, a digital process control computer has been introduced. The philosophy of its use, the supplementary hardware developed and the applications realized are described. (Netherlands)

52331 THREE-SECTOR FOCUSING MAGNETIC PRISMS WITH r^{-1} FIELD. PART 4. FOCUSSING OF CYLINDRICAL

CHARGED PARTICLE BEAMS. Fedoseev, E. P. (Atomic Energy In t., Moscow). Kernenergie: 13: 228-31(Jul 1970). (In Russian).

For cylindrical beams the focusing parameters of three-sector magnetic prisms with r^{-1} field have been obtained and investigated in part. The conditions giving stigmatic first-order and second-order focusing are considered. (auth)

52332 ACCELERATION OF ELECTRONS IN A PLASMA BETATRON WITH AND WITHOUT HIGH CONDUCTION CURRENT. Bermel, W. (Univ., Bonn). Z. Phys.; 237: 345-67(1970). (In German).

A previous paper by Drees and Paul reported measurements on a plasma betatron. The study was continued using a betatron field with a vector potential taking into account the self magnetic field of a plasma current. The plasma was produced by a high frequency electric quadrupole field without an azimuthal magnetic field. The bremsstrahlung intensity of the accelerated electrons was observed as a function of gas pressure and accelerating field. The maximum energy of the electrons was 1.3 MeV compared to 1.5 MeV given by the field parameters. The maximum number in this energy range was about 10^{10} per pulse corresponding to a circulating runaway current of ~1 A. The conduction current was drastically reduced by coating the inner wall of the quartz glass torus with a thin layer of graphite. This change in the plasma current did not influence the γ radiation intensity. (auth)

52333 FAST SHUTTER FUNCTIONING UNDER VACUUM. Salle, H. (Clermont-Ferrand Univ., France). Mes., Regul., Automat.; 35: 82-6(Jun 1970). (In French).

The principle and the development of a blind-type shutter capable of chopping up a beam of heavy ions into pockets of between 10^{-6} and 10^{-4} seconds are described. A list of possible applications is presented. (auth) (France)

52334 RADIATION DAMPING OF LARGE-AMPLITUDE SYNCHROTRON OSCILLATIONS. Dovbnya, A. N.; Kononenko, S. G.; Reprintsev, L. V.; Shenderovich, A. M. Sov. Phys.-Tech. Phys. (Engl. Transl.); 15: 200-5(Aug 1970).

Translated from Zh. Tekh. Fiz.; 40: 275-82(Feb 1970).

Analytical expressions are derived for the radiation damping rate of nonlinear synchrotron oscillations. It is shown that, in this case, phase damping occurs much more quickly, and energy damping more slowly, than in the case of small oscillations. For sufficiently small values of the cosine of the phase angle, the time dependence of the amplitude of phase oscillations has a universal character and is independent of the parameters of a given accelerator. The results agree with the exact computer solution and the experimental data obtained on a 70-MeV electron storage ring. (auth)

52335 NUCLEAR DATA ACQUISITION WITH A LARGE 2nd GENERATION COMPUTER. Hiebert, J. C.; Hamilton, C. C.; Sathre, T. H.; Rogers, R. C. (Texas A and M Univ., College Station). Nucl. Instrum. Methods; 86: 45-54(1970).

An IBM 7094 computer system is used for real-time data acquisition at the Texas A & M Variable Energy Cyclotron (TAMVEC) facility. The IBSYS monitor has been modified to support a multiprogramming environment in which data acquisition functions are handled automatically while the user either monitors the data acquisition or analyzes previously acquired data. The heart of the acquisition system is a control interface, in which an experiment is configured under software control. (auth)

52336 LIVERPOOL NUCLEAR STRUCTURE ON-LINE COMPUTER SYSTEM. Alderson, P. R.; Dawson, N. (Univ. of Liverpool). Nucl. Instrum. Methods; 86: 35-43(1970).

An on-line data collection and analysis system is described. It has been designed to control data collection, give an event by event record of an experiment on magnetic tape, provide initial on-line data analysis into a maximum of 64K of spectra stored on a magnetic drum and display any spectra and other information the physicist requires. All programs are stored on the drum with fast direct transfer to core for execution upon receipt of simple teletype commands. (auth)

52337 DESIGN OF MAGNETIC FIELD CLAMPS. Huebner, H.; Wollnik, H. (Justus-Liebig Univ., Giessen, Ger.). Nucl. Instrum. Methods; 86: 141-8(1970).

Field clamps are discussed here regarding their ability to effectively limit the extension of the fringing field of a magnet. Saturation effects in the fringing field distribution are studied in and off the median plane. The design of a field clamp used on a magnet with rounded off pole tips is proposed that up to high field strengths shows no change in the well limited fringing field distribution. (auth)

52338 SOURCE OF POLARIZED NEGATIVE HYDROGEN IONS FOR A TANDEM ACCELERATOR. Grueebler, W.; Koenig, V.; Schmelzbach, P. A. (Eidgenoessische Technische Hochschule, Zurich). Nucl. Instrum. Methods; 86: 127-39(1970).

A source of polarized negative hydrogen ions is described. It consists of an atomic beam apparatus with strong-field ionizer producing polarized proton or deuteron beams of 1.1 μA. Negative ions are formed without depolarization by charge exchange in sodium vapor. Different spin polarizations and orientations for deuterons can be induced by the use of rf transitions and a crossed field analyzer. The source yields, after acceleration to 60 keV, a polarized negative ion intensity of 10 to 20 nA. After acceleration in the tandem generator a pure vector polarization of typically $P_3 = 0.5$ and a tensor component $P_{33} = 0.75$ was measured. The beam intensity focused on a spot of 0.3 cm diameter in a scattering chamber is typically 1.5 nA. (auth)

52339 RADIATIVE NEUTRON CAPTURE FACILITY AT THE UNIVERSITY OF TORONTO. Ing., H.; Smith, B. St. John; Wahrer, R.; King, J. D.; MacRae, G. S.; McConnell, D. B.; Paul, D. A. L.; Taylor, H. W. (Univ. of Toronto). Nucl. Instrum. Methods; 86: 19-28(1970).

A description is given of the facility for performing resonance-neutron radiative-capture experiments at the University of Toronto linac laboratory. The shape of the neutron spectrum produced by bremsstrahlung on tungsten plates in the thermal and resonance energy region is presented. Investigations of the "γ-flash" accompanying the neutron bursts reveal a large component due to annihilation radiation. As an example of system performance, the results from neutron capture in ^{197}Au are displayed. (auth)

52340 BIASED SOURCE FOR A CYCLOTRON. Bennett, J. R. J. (Rutherford Lab., Chilton, Eng.). Nucl. Instrum. Methods; 86: 13-17(1970).

A description is given of an ion source at a positive bias potential located on the axis of a cyclotron. The source was used to simulate the beam from an axial injector for studying the requirements of the central region geometry in a cyclotron to be equipped with an axial injection system. The results of beam measurements in the cyclotron are presented. It is shown that the biased source can have advantages over a conventional source; particularly in conjunction with axial injection. (auth)

52341 LOS ALAMOS MESON PHYSICS FACILITY. Burman, Robert L. (Los Alamos Scientific Lab., N. Mex.). pp 544-50 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The experimental facilities for the LAMPF are briefly described. Experimental area A contains the meson production targets. Details of the expected performance are given for the muon channel, low energy pion channel, and high energy pion channel. Experimental area B is intended for studying nucleon–nucleon interactions, and area C is being designed for nuclear structure research with the proton beam. (W.H.K.)

52342 700 MeV HIGH INTENSITY PHASOTRON (Design Status). Dzhelepov, V. P. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 551-5 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The development of a 50-μA 700-MeV proton synchrocyclotron for meson production is described. The magnetic system, rf system, targets, and beam extraction system are briefly described. (W.H.K.)

52343 SIN RING CYCLOTRON PROJECT STATUS REPORT. Blaser, J. P.; Willax, H. A.; Gerber, H.-J. (Swiss Inst. for Nuclear Research, Zurich). pp 556-65 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A two stage isochronous accelerator for proton-beams of at least 100 μA at 585 MeV is under construction at the Swiss Institute for Nuclear Research at Zurich. It consists of a sector focussed isochronous cyclotron for 70 MeV acting as injector, and an isochronous ring cyclotron. A prototype of the C-shaped sector magnets, and of the rf accelerating cavities have been tested successfully. Accelerator components are being manufactured. Building construction work has started and installation of the machine will begin in 1971. (auth)

52344 TRI-UNIVERSITY MESON FACILITY. Warren, J. B. (TRIUMF, Vancouver, Can.). pp 566-75 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The development of the six-sector AVF cyclotron to accelerate 100 μA of H^- ions to 500 MeV is described. The H^- ions are passed through a stripping foil for proton extraction. The magnet design; rf system; injection and central region; vacuum system; meson area, targets, and secondary beams; and the proton area are discussed. (W.H.K.)

52345 ELECTRON ACCELERATORS: THE SACLAY LINEAR ACCELERATOR (ALS). Messiah, A. M. L. (CEN, Saclay, France). pp 578-86 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The design and operation parameters of the Saclay linear accelerator and the MIT linear accelerator are summarized. Also, the most significant results from the first operation of the Saclay linac are outlined, and the experimental facilities and the experimental program are described. (W.H.K.)

52346 PRINCETON-PENNSYLVANIA 3 GeV PROTON ACCELERATOR AS A NUCLEAR TOOL. White, Milton G. (Princeton-Pennsylvania Accelerator, Princeton, N. J.). pp 587-94 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Experimental facilities for nuclear research at the Princeton–Pennsylvania Accelerator are described, and the improvement program is discussed. The heavy ion improvement program, directed toward the search for the super heavy transuranic elements and the acceleration of the heaviest ions, is outlined. (W.H.K.)

52347 NEVIS SYNCHROCYCLOTRON CONVERSION PROJECT. Cohen, R. (Columbia Univ., New York); Martin, E.; Rainwater, J.; Schneider, R.; Ziegler, K.; Ohnuma, S. pp 603-5 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The program for converting the 380-MeV proton synchrocyclotron at Columbia University into a 550-MeV accelerator with a long duty cycle (5 to 40 μA time average) is described. Spiral ridge sector magnets for AVF focusing, the rf system, and the beam extraction system are briefly discussed. (W.H.K.)

52348 POSSIBILITY OF USING STORAGE RINGS WITH INTERNAL THIN TARGETS. Belyaev, S. T.; Budker, G. J.; Popov, S. G. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 606-9 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

An equation is presented and discussed for the beam lifetime as a function of the cross sections of the processes and the target thickness. The possibilities and advantages of storage rings with thin internal targets are discussed. (W.H.K.)

52349 PRELIMINARY REPORT ON A 500-MeV LINAC-POWERED RACE-TRACK MICROTRON FOR THE UNIVERSITIES OF NORTHWEST ITALY. Gonella, L.; Manuzio, G.; Malvano, R. (Univ., Genoa, Univ., Pavia, Italy. Univ., Turin, Istituto Nazionale Fisica Nucleare, Turin). pp 610-12 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A proposal for a microtron is discussed. The accelerator will have an output of about 500 MeV, with average useful beam power of 10 to 20 kW at 3% duty cycle to be reached in 25 to 30 orbits with a magnetic field of about 1.5 Wb/m^2, an injection energy of 12 to 20 MeV, and a gain per turn of 15 to 20 MeV, obtained with two conventional L-band linac sections excited with two 75-kW klystrons. (W.H.K.)

52350 PRECETRON: A PRINCIPLE FOR OBTAINING PION–PION AND MUON–MUON COLLISIONS. Macek, Robert; Maglic, Bogdan (Univ. of Pennsylvania, Philadelphia). pp 613-14 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A device for pion–pion collisions in the mass region of ρ^- meson has been proposed and its parameters calculated. It operates on the following idea: over 10^{13} π^+ and π^- in the momentum range $P_\pi = 300-550$ MeV/c are produced by a short burst of 6×10^{15} protons of 800 MeV incident onto a metal target placed in the center of a 400 Kgauss (pulsed) magnetic field, extending over a radius of $R \simeq 5$ cm and shaped to contain ~100 turns of pions. Pion orbits are circles tangential to the target; π^+ and π^- orbits precess in opposite directions, the locii of their centers being circles of radius $r \simeq \frac{1}{2}R$ whose origin is at the target. The $\pi^+-\pi^-$ collisions of interest take place in the peripheral region of this "magnetic pot," where the crossing angles of the intersecting precessing orbits are smallest. This orbit-precession device, called "precetron," has a large momentum acceptance of pions, $\Delta p/p \simeq 50\%$ and large angular acceptance, 0° to 180° in horizontal and ±10° in vertical plane, in contrast to a conventional storage ring which would require well-defined momentum and small angular divergence in order to have the pions captured. (W.H.K.)

52351 POSSIBLE SOURCES OF RESIDUAL POWER LOSS IN R.F. SUPERCONDUCTING CAVITIES. Rabinowitz, M. (Stanford Univ., Calif.). Lett. Nuovo Cim.; 4: 549-55(19 Sep 1970).

Recent experiments indicate that, for very-high-Q superconducting cavities, the residual surface resistance R_{res} is independent of temperature and field level, is proportional to the square of the rf frequency ω, and is present even for extremely small stored energy. It is suggested that the most likely source of the residual power loss is a small, stationary normal region within the superconducting surface. Two sources of this power loss are shown to have the correct frequency- and temperature-dependence: an induced current loss which results from the time-varying magnetic flux and a loss due to the presence of an electric field in the ac superconductor. Other possible loss mechanisms are considered, but they do not yield the correct dependence on temperature and/or frequency. (R.W.R.)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 50577, 51818, 51844, 52247, 52339, and 52571.

52352 (AD-705150) A NUMERICAL STUDY OF TRANSPORT PHENOMENA IN SPHERICAL GEOMETRY BY THE METHOD OF INVARIANT IMBEDDING. Final Report. Allen, R. C. Jr.; Shampine, L. F.; Wing, G. M. (New Mexico Univ., Albuquerque). Apr 1970. 87p. (DASA-2421). CFSTI.

For several years the method of invariant imbedding has been used in the numerical study of transmission and reflection properties of materials subjected to flux of particles (neutrons, protons, etc.). In the past, such calculations have been confined to problems involving infinite slabs of transport materials. In the present report the transmission and reflection problem for spherical geometries is investigated both analytically and numerically. Several calculational algorithms have been devised, tested, and compared. Graphs, computer printouts, and the complete computer program are included. (auth) (USGRDR)

52353 (BNWL-1432) HRG3: A CODE FOR CALCULATING THE SLOWING-DOWN SPECTRUM IN THE P_1 OR B_1 APPROXIMATION. Carter, J. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jun 1970. Contract AT(45-1)-1830. 126p. Dep. CFSTI.

The HRG3 computer program is written in FORTRAN 4 for the UNIVAC 1108 computer system. The program computes the slowing-down spectrum over the energy range 10 MeV to 0.414 eV in either the B_1 or P_1 approximation, using 68 groups of neutrons with a constant group width of delta u = 0.25. The calculated flux and current spectra are used to reduce the original 68-group cross-section data to average values over as many as 33 broad groups. (auth)

52354 (BNWL-1434) BRT-1: BATTELLE-REVISED-THERMOS. Bennett, C. L.; Purcell, W. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jun 1970. Contract AT(45-1)-1830. 86p. Dep. CFSTI.

A FORTRAN IV program is described which computes the space-dependent thermal neutron density, flux, and current spectra over the energy range 0 to 0.683 eV in either slab or cylindrical geometry. The neutron density is computed from the collision probability form of the integral transport-theory matrix equation using either a combination of power iteration, overrelaxation and extrapolation or straight power iteration. The neutron currents are computed from either the gradient of the scalar flux or the uncollided flux matrix. The flux and current spectra are used to weight point thermal cross sections over an arbitrary thermal energy range for use in multigroup transport or diffusion theory codes. The code requires 64K memory and 3 scratch units, in addition to the normal I/O complement. Typical running time with a random-access library on a UNIVAC 1108 is 1 minute with a reflecting boundary condition and 30 seconds with a white boundary condition; succeeding cases using the same cross sections take about 15 seconds each. (R.W.R.)

52355 (CEA-CONF-1565) ELF PROGRAM. Gervaise, Francois (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1969. 12p. (In French). (CONF-690963-1). Dep. CFSTI (U. S. Sales Only).

From National Meeting on Digital Analysis, Bordeaux, France.

The ELF program is a polykinetic study of neutron propagation using a Monte Carlo method and cross section data available from the AWRE library program. The W normality test is used to avoid setting-up difficulties. (auth) (France)

52356 (CEA-CONF-1567) WEIGHTING AND BIAS IN A MONTE CARLO CALCULATION FOR NEUTRONS IN THE CASE OF DEEP PENETRATION. Lanore, Jeanne-Marie (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1969. 17p. (In French). (CONF-690963-2). Dep. CFSTI (U. S. Sales Only).

From National Meeting on Digital Analysis, Bordeaux, France.

From the solution of an equation associated with the transport equation a weighted biassed system was established which allows a constant variance to be calculated for every point in phase space using a Monte Carlo method. A rigorous solution is obtained for a particular case and almost rigorous solutions obtained for the general case. Thus the spectra of neutrons far from their source were determined with great accuracy. (auth) (France)

52357 (EUR-4496) SCATTERING OF SLOW NEUTRONS BY ORTHOHYDROGEN. Olivi, L. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 23 Apr 1970. 20p. Dep. CFSTI (U. S. Sales Only). EUR FF 4.45.

The differential and total slow-neutron scattering cross sections of orthohydrogen were derived by taking into account the removal of the degeneracy of the rotational states of the molecule. The result shows that the cross sections depend on the direction of quantization, as is expected. A numerical calculation for application was performed in some typical cases, and the result is shown graphically. (auth)

52358 (FMRB-6) CADMIUM RATIO IN THE NEIGHBORHOOD OF A NEUTRON SOURCE IN WATER. Bortfeldt, H. J.; Matzke, M. (Physikalisch-Technische Bundesanstalt, Brunswick (West Germany)). Jul 1968. 13p. (In German). Dep. CFSTI (U. S. Sales Only).

The assumption that the Cd ratio varies only slightly with the distance from the source in water was tested in source strength measurements. The results show that the measured pattern of $\varphi_{th}(r)/\varphi_{epi}(r)$ was represented correctly with the help of the simple diffusion theory. With increasing distance from the source a slight drop of the Cd ratio was shown in the case $L\Sigma < 1$. The asymptotic value is, however, only several percent under the maximum value so that there are no effects introduced by the extrapolation method used in source strength measurements. The asymptotic value of the Cd ratio depends strongly on the parameters Σ and L when $L\Sigma \approx 1$. A determination of Σ or L from this value should be possible. The different places of the maxima of $\varphi_{th}/\varphi_{epi}$ in the Ra-Be and Am-Be sources is probably connected with the differing spectra of the primary neutrons. The difference is much more prominent than in the epithermal neutron flux densities multiplied by r^2. A spectrum parameter (as the Fermi age) can be determined more accurately from the location of the maximum. (tr-auth)

52359 (FOA-4-4433-22) CONTRIBUTION TO AN IAEA PANEL ON NEUTRON DATA COMPILATION HELD IN BROOKHAVEN, 10-14 FEBRUARY 1969: "DATA CENTRES, WHO WANTS WHAT AND WHY"? Wallin, L. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Jul 1970. 12p. (CONF-690204-6). Dep. CFSTI (U.S. Sales Only).

From IAEA Panel on Neutron Data Compilation, Upton, N. Y.

An attempt is made at defining what services a data center should give. The form that these services should be to serve the various groups of users in the best possible way is analyzed. Different user groups are identified. From an analysis of the characteristic functions of each of these user categories conclusions are drawn as to what services they need from a data center. Some implications for the operation of data centers and kind of staff are given. The extent to which the present centers fulfill these desirable services is discussed. The importance of specific services for the question of how to increase the use of the data centers is stressed. The opinions are based on the experience as member and user of a data center. (auth) (Sweden)

52360 (IAE-1875) SOLUTION OF THERMALIZATION PROBLEMS BY THE QUASI-DIFFUSION METHOD. Trukhanov, G. Ya. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1969. 35p. (In Russian). Dep. CFSTI (U. S. Sales Only).

A description is presented of the extension of the quasi-diffusion method of solving the kinetic equation to problems of thermalization. The rapid convergence of the quasi-diffusion method in such problems, for a broad range of heterogeneous systems with high temperature gradients and strong absorption, is demonstrated (the presence of resonance absorbers is also considered). The effect of chemical bonds and kinetic effects on differential neutron spectra and on their integral characteristics in graphite-water absorptive systems in the presence of temperature jumps is studied at the graphite-water interface. A summary is given of the iteration method, which combines the principles of the collision method with those of the overlapping-group method. A corresponding system of equations is derived. 10 references. (auth)

52361 (JAERI-1195(Pt.1)) JAERI FAST REACTOR GROUP CONSTANTS SYSTEMS. PART I. Katsuragi, Satoru; Tone, Tatsuzo; Hasegawa, Akira (Japan Atomic Energy Research Inst., Tokai. Tokai Research Establishment). Feb 1970. 140p. Dep. CFSTI (U. S. Sales Only).

A concept of fast group constants has been studied and a processing program has been developed using the ENDF/A format.

An evaluation work has been performed from standpoint of reactor physics in order to find better interpretations of nuclear data for producing group constants. Three files, UKNDL, ENDF/B and KFK 120 (I, II, III and KFK 750) were compared with each other. A set of appropriate nuclear data was obtained. Using the processing program and nuclear data, group constants have been produced for the following elements: ^{10}B, ^{11}B, C, O, Na, Al, Cr, Fe, Ni, Cu, ^{235}U, ^{238}U, ^{239}Pu, ^{240}Pu and ^{241}Pu. The following quantities are prepared for users: 70-group cross section tables and 25-group cross section tables for infinite dilution, inelastic scattering matrices, 70-group fluxes for several values of admixture cross section σ_0 and tables of self shielding factor f. 52 references. (auth)

52362 (KAPL-P-3892) A NEW FORM OF THE P_3 APPROXIMATION. Selengut, D. S. (Knolls Atomic Power Lab., Schenectady, N. Y.). [1967]. Contract W-31-109-eng-52. 5p. (CONF-701102-1). Dep. CFSTI.

For Presentation at Meeting of the American Nuclear Society, Washington, D. C.

The complete P_3 approximation equations are developed in a form which retains the computational advantage of the simplified theory. Isotropic scattering and sources are assumed, and cross sections are taken to be constant within each region. 4 references. (auth)

52363 (KFK-1126) PSEUDOSTATISTICAL TIME-OF-FLIGHT METHOD FOR SCATTERING EXPERIMENTS WITH SLOW NEUTRONS. Gompf, Folker (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Apr 1970. 60p. (In German). Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Technische Hochschule, Karlsruhe (West Germany).

A description of an improved time-of-flight method for scattering experiments with slow neutrons is presented. Instead of pulsing the continuous reactor beam periodically, the neutrons are now pseudostatistically modulated by a neutron chopper. In comparison with the classical time-of-flight method, where the time utilization of the reactor beam is smaller than 1%, it is now raised to 50%. It is shown that a statistical chopper is advantageous in those cases where the time-of-flight spectrum consists of a number of peaks which have amplitudes larger than the average amplitude. The method is also advantageous in all cases where the background is very high. A spectrometer for pseudostatistical time-of-flight measurements was built to be used for elastic and inelastic neutron scattering experiments. Investigations on the structure of $BiFeO_3$ and on phonons in Ag and Au are described that were not feasible before because of low neutron intensity. 22 references. (auth)

52364 (LA-4410) ANDY1G2 AND ANDY1R2: MONTE CARLO PROGRAMS FOR TIME-DEPENDENT MONOENERGETIC PARTICLE TRANSPORT IN GENERAL GEOMETRIES AND REPEATING ARRAYS. Harris, D. R. (Los Alamos Scientific Lab., N. Mex.). Jun 1970. Contract W-7405-eng-36. 14p. Dep. CFSTI.

The ANDY1G2 and ANDY1R2 programs in FORTRAN 4 for the CDC 6600 compute time-dependent, monoenergetic particle transport in, respectively, general geometries without repeating arrays, and general geometries with repeating arrays. In the latter case, moments of spatial distributions of collisions are computed at option. Particle emission from collisions is isotropic in the laboratory coordinate system and can be delayed. 5 references. (auth)

52365 (NP-18368) METHODS FOR CALCULATING GROUP AVERAGE CROSS SECTIONS IN THE UNRESOLVED RESONANCE REGION. Nikolaev, M. N.; Abagyan, L. P.; Petrova, L. V.; Poplavskaya, T. A.; Korchagina, Zh. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1968. 19p. Dep. CFSTI (U. S. Sales Only).

The procedures involved in calculating the average group cross section are presented; the resonance self-shielding in the region of unresolved resonances is taken into account. For this purpose the parameters of quasi-random sequence of resonances are obtained; fluctuations in neutron width and distance between the levels are considered in this calculation. (auth)

52366 (NP-tr-1922) NUCLEAR PHYSICS RESEARCH IN THE USSR (COLLECTED ABSTRACTS). NO. 5. Translation of Yaderno-Fizicheskie Issledovaniya v SSSR, Atomizdat, Obninsk, 1967. 71p. (INDC-232). Dep. CFSTI (U. S. Sales Only).

A collection of abstracts on nuclear physics research in the U.S.S.R. is presented. (D.C.C.)

52367 (NP-tr-1923) NUCLEAR PHYSICS RESEARCH IN THE USSR (COLLECTED ABSTRACTS). NO. 6. Translation of Yaderno-Fizicheskie Issledovaniya v SSSR, Atomizdat, [Moscow], 1968. 153p. (INDC-260-E). Dep. CFSTI (U. S. Sales Only).

A collection of abstracts on nuclear physics research in the U.S.S.R. is presented. (D.C.C.)

52368 (NP-tr-1924) NUCLEAR PHYSICS RESEARCH IN THE USSR (VOLUME OF ABSTRACTS). NO. 4. Translation of Yaderno-Fizicheskie Issledovaniya v SSSR, [Atomizdat], Obninsk, 1967. 63p. (INDC-187). Dep. CFSTI (U. S. Sales Only).

The abstracts of work on the experimental or theoretical analysis of nuclear reactions induced by neutrons of energies up to 20 to 30 MeV are presented. Work on the fission of nuclei is also described. Investigations carried out in certain institutes in the Soviet Union in the second half of 1966 are reviewed. (auth)

52369 (NP-tr-1925) NUCLEAR PHYSICS RESEARCH IN THE USSR (VOLUME OF ABSTRACTS). NO. 3. Translation of Yaderno-Fizicheskie Issledovaniya v SSSR, [Atomizdat], Obninsk, 1966. 29p. (INDC-140). Dep. CFSTI (U. S. Sales Only).

The abstracts of work on the experimental and theoretical analysis of nuclear reactions involving particles with energies up to about 20 MeV and also on nuclear fission are listed. Work carried out at a number of institutes in the Soviet Union during the first half of 1966 is reviewed. (auth)

52370 (ORNL-TM-3031) 06R-D, A DISCRETE SCATTERING VERSION OF 06R WITH IMPORTANCE SAMPLING OF THE ANGLE OF SCATTER. Burgart, C. E. (Oak Ridge National Lab., Tenn.). 13 Aug 1970. 40p. Dep. CFSTI.

Discrete angle scattering, angular importance sampling, and angular-dependent path-length stretching have been incorporated into 06R, a Monte Carlo neutron transport code. A description is included of the modifications and additions to 06R and NUSECT, the cross-section preparation code. A brief description of the methods of importance sampling is presented in the context of 06R-D. An example of a method of preparation of importance sampling parameters is also presented. 7 references. (auth)

52371 (UCRL-50856) CALCULATIONS OF THE TRANSPORT OF NEUTRONS FROM A (d,t) SOURCE THROUGH MANY MEAN FREE PATHS IN LIQUID NITROGEN. Sauter, G. D.; Robinson, P. A. (California Univ., Livermore. Lawrence Radiation Lab.). 17 Apr 1970. 21p. Dep. CFSTI.

Calculations were made of neutron transport through liquid nitrogen, with the (d,t) source and the neutron detector both located in the liquid nitrogen. The detector-output pulse height spectra expected for various source-detector distances were calculated by a Monte Carlo technique, using two different libraries (i.e., sets) of nitrogen cross sections representing limit values. Comparisons of the calculated spectra with measured spectra show that the shapes are nearly identical. However, the magnitudes differ (by about 50% at 10 mean free paths for 14-MeV neutrons) depending on which cross section library is used. The neutron fluences at various distances from a point (d,t) source in an infinite medium of liquid nitrogen have also been calculated using the same libraries. Plots of the variation of these fluences with distance from the source for the various neutron-energy groups and with neutron energy for certain distances are presented. (auth)

52372 GEOMETRIC INTERPRETATION OF THE FUNCTION $g(c,\mu)$ OF NEUTRON TRANSPORT THEORY. Newman, Perry A. (Langley Research Center, Hampton, Va.); Bowden, Robert L. Nucl. Sci. Eng.; 41: 309-10(Aug 1970).

The function $g(c,\mu)$ introduced by Case et al. (NSA 9: 347) is considered in the domain of time-dependent monoenergetic neutron-transport problems in plane geometry with isotropic scattering. A geometrical interpretation of the function $\alpha^{-2}g(1/\alpha,\mu)$ is given. (R.W.R.)

52373 SLOW NEUTRON SCATTERING ROUTINE FROM THE GAS MODEL. Eriksson, John R. (Aktiebolaget Atomenergi, Studsvik, Sweden). Nucl. Sci. Eng.; 41: 307-9(Aug 1970).

A simplified scattering routine for slow neutrons is derived from a scattering formalism given by Zemach and Glauber (NSA 10: 4851), under the assumption of a Maxwellian energy distribution for the scattering medium. It is shown that the laboratory system differential cross section is independent of the neutron masses and temperatures. It is written in terms of two dimensionless variables, μ and Z; after being properly evaluated, these lead to the final neutron velocity v'. (R.W.R.)

52374 THERMAL NEUTRON SOURCE. Briand, Alain (to Commissariat a l'Energie Atomique). British Patent 1,191,807. 13 May 1970. Priority date 21 May 1968, France.

A thermal neutron source having a controllable temperature and so designed that the energy of neutrons supplied by a nuclear reactor core may be modified externally at will is described. A block of neutron-moderating material is placed in a vacuum-tight casing inside a reactor core. The energy of the neutrons passing through the block can be varied by changing its temperature; this is accomplished by directing externally produced waves down a wave guide to the block. The wave source may be a magnetron, a laser, or an arc furnace. (R.W.R.)

52375 NEUTRON FOCUSING BY A CURVED SOLLER COLLIMATOR SYSTEM. Friedmann, M.; Rauch, H. (Oesterreichische Hochschule, Vienna). Nucl. Instrum. Methods; 86: 55-9 (1970).

The focusing action of a curved totally reflecting multi-channel arrangement is investigated as far as cold and thermal neutron spectra are concerned. The system consists of 45 Ni-coated channels with a curvature of 40 m and with lengths varying between 53 and 157 cm and slit widths of 0.5 to 1.4 mm. The intensity gain at the focal area is connected with an enlargement of the angular divergency. The advantages of such systems are discussed. (auth)

52376 NEUTRON SPECTRUM MEASUREMENTS IN A HOMOGENEOUS ERBIUM SYSTEM AND ERBIUM CROSS SECTIONS. Gozani, T.; Trimble, G. D. (Gulf General Atomic, Inc., San Diego, Calif.). Nucl. Sci. Eng.; 41: 164-76(Aug 1970).

Careful measurements and calculations of the neutron spectrum in an aqueous solution of erbium nitrate are described. The validity of the infinite medium calculation is scrutinizingly studied. As a result it is shown that the discrepancy between measurement and calculation is caused by a too high (by about 10%) absorption cross section of erbium. This result is substantiated by two independent integral tests; the fundamental time eigenvalue of the system and the neutron conservation test. (auth)

52377 INTERACTION OF NEUTRONS WITH BLOCH-WALLS. Rauch, H.; Rockenbauer, G.; Rupar, H. (Oesterreichische Hochschule, Vienna). Atomkernenergie; 15: 275-9(1970). (In German).

The interaction of neutrons with static and moving Bloch walls is described. New aspects arise out of the interaction with rapidly moving walls, because wall velocities comparable to the neutron velocities can be obtained. The calculations demonstrate a marked change of the neutron polarization for inclined transmission of the neutrons through the wall. Multiple total reflection on a wall moving with a constant deceleration causes an energy loss of the neutrons. Neutron depolarization experiments and investigations of the walls at the surface with the Bitter-method show the existence of large static flat walls in Co single crystals. (auth)

52378 THEORY OF THERMAL NEUTRON SCATTERING FROM CRYSTALS CONTAINING IONS WITH UNPAIRED f ELECTRONS. Balcar, E.; Lovesey, S. W.; Wedgwood, F. A. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., C (London); 3: 1292-1302(Jun 1970).

The problem of calculating the magnetic contributions to the cross section for the scattering of polarized thermal neutrons by crystals containing ions with unpaired f electrons is reduced to the evaluation of simple expressions that involve spherical harmonics and certain functions characteristic of the ion in question. These "characteristic" functions (at most four per ion) are tabulated for tripositive rare earth ions. For the particular case of saturated ions the magnetic contribution to the elastic cross section is shown to be contained in a generalized atomic form factor. Three numerical examples are given, namely Pr^{3+}, Sm^{3+} and Er^{3+}, and it is shown that the form factor for Sm^{3+} possesses a maximum at a non-zero value of the scattering vector. (auth) (UK)

52379 CALCULATION OF DECAY CONSTANTS IN BERYLLIUM OXIDE IN THE REGION OF $(v\Sigma_{inel})_{min}$. Ritchie, A. I. M. (Wollongong University Coll., New South Wales); Maher, K. J.; Trimble, Graham D. J. Nucl. Energy; 24: 151-5(Jun 1970).

The time dependent reaction rate of a 1/v detector in various sized BeO assemblies was calculated at various times after an initial neutron pulse using multigroup diffusion theory. The results showed excellent agreement with recent experiments and indicate the apparent ability of diffusion theory to describe pulsed polycrystalline assemblies. (auth)

52380 STUDY OF THERMAL NEUTRON SPECTRA IN HOMOGENEOUS MEDIA. 1. SPECTRA IN QUASI-INFINITE POISONED WATER. Aizawa, Otohiko (Tokyo Inst. of Tech.); Kadotani, Hiroyuki; Fujita, Yoshiaki. Bull. Tokyo Inst. Technol. (Engl. Ed.); No. 96, 55-70(Mar 1970).

Neutron energy spectra in pure and B, Cd and Gd poisoned water were measured by time-of-flight method with the pulsed neutron source from a linear accelerator. Results are compared with theoretical calculations based on three different models. Agreement between theory and experiment is fairly good for heavily poisoned systems while for pure and lightly poisoned water the experimental spectra were 10 to 20% harder than theoretical predictions. (auth)

52381 POLARIZATION IN NEUTRON–DEUTERON ELASTIC SCATTERING AT 1.2 MeV. Smith, D. L.; Miller, T. G. (Army Missile Command, Redstone Arsenal, Ala.). Nucl. Phys.; A147: 509-12(1970).

The neutron–deuteron polarization function $P_d(\theta_3)$ has been measured by scattering 1.2 MeV polarized neutrons from a deuterated benzene liquid scintillator at 5° intervals within the angular range 50 to 130° lab. The polarization was found to be consistent with zero at most angles in general agreement with other measurements reported for this energy region. (auth)

52382 REPRESENTATION OF THE ANGULAR DEPENDENCE OF NEUTRON DISTRIBUTION FUNCTION BY MEANS OF GEGENBAUER POLYNOMIALS. Platovskikh, Yu. A.; Sergeev, I. V. This paper was summarized in At. Energ. (USSR); 26: 282(Mar 1969) as paper No. 266. (In Russian).

The distribution function for neutrons in plane geometry is represented by a series containing the Gegenbauer polynomials. The accuracy of the method is compared with that of the formulation using the P_n approximation. (J.W.R.)

52383 RETHERMALIZATION LENGTHS IN GRAPHITE AND WATER. Abdullaev, Kh. Sh.; Nikitin, V. D.; Trukhanov, G. Ya. This paper was summarized in At. Energ. (USSR); 26: 538-9 (Jun 1969) as paper No. 306. (In Russian).

The rethermalization lengths in graphite and water are calculated using experimental data. Data on temperature changes in neutron gases are used in analytic expressions obtained by the intersecting group method for the space relationship of the neutron gas temperature and which contain the rethermalization length as a parameter. A method is also described for directly reconstructing the rethermalization length from the neutron spectra. (J.W.R.)

52384 RELAXATION LENGTHS IN WATER. Abdullaev, Kh. Sh.; Nikitin, V. D.; Trukhanov, G. Ya. This paper was summarized in At. Energ. (USSR); 26: 537-8(Jun 1969) as paper No. 307. (In Russian).

The meaning of relaxation lengths used in various methods for solving the equation of motion for a neutron flux is explained. The eigenvalue spectra of the exact equation of motion, of the equation of motion in P_1 approximation, of the method of overlapping groups in P_1 approximation, and of the generalized method of overlapping groups are examined. The problem of whether a discrete first relaxation length of the neutron flux can exist in water is discussed. (J.W.R.)

52385 MEASUREMENT OF THE SCATTERING CROSS SECTIONS OF LIQUID AND SOLID HYDROGEN, DEUTERIUM, AND DEUTERIUM HYDRIDE FOR THERMAL NEUTRONS. Seiffert, W. D.; Weckermann, B.; Misenta, R. (EURATOM, Ispra, Italy). Z. Naturforsch.; 25a: 967-72(Jun 1970). (In German).

The total cross section of thermal neutrons of liquid and solid normal-hydrogen, para-hydrogen, deuterium and deuterium hydride were measured at several temperatures. The cross section of the liquid and solid phase of para-hydrogen shows that the para-hydrogen molecule scatters coherently. The coherence effects in the cross sections of liquid para-hydrogen and deuterium indicate a short range order of the molecules in the liquid. The cross sections of para-hydrogen and deuterium hydride show clearly the excitation of the first rotational level of the molecule. The threshold indicates that the molecules of the liquid phase are not completely free. The cross section of liquid and solid para-hydrogen for neutrons with energies larger than the threshold energy show a different behavior that can be explained by the different dynamics of liquid and solid. (auth)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstracts 51797, 51919, 51942, 52113, 52135, 52143, 52441, 52479, 52501, and 52546.

52386 (BNL-50233) HALF-LIVES OF ^{3}H AND ^{238}Pu. Sher, R. (Brookhaven National Lab., Upton, N. Y.). Apr 1970. 5p. Dep. CFSTI.

The available measurements of the half-lives of tritium (^{3}H) and plutonium-238 are reviewed. Only recent values with relatively high precision are considered. Earlier measurements with large stated uncertainties are ignored. Final recommendations are listed. (auth)

52387 (LNF-69/82) PHOTODISINTEGRATION OF ^{3}He BY POLARIZED GAMMA RAYS. Note No. 463. Fabbri, F. L.; Picozza, P.; Schaerf, C. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 23 Dec 1969. 3p. Dep. CFSTI (U. S. Sales Only).

The p-d coincidences resulting from bombardment of a liquid helium target by linearly polarized gamma rays were measured. The detectors consisted of a NaI(Tl) crystal and several plastic scintillators, and particle identification was used. The result of this preliminary measurement for the asymmetry parameter A is $A = 0.36 \pm 0.08$ at a cms angle of 90° and a gamma ray energy of 260 MeV. This result indicates that the M1 contribution is at least comparable to the E1, and it should be taken into account in future theoretical calculations. (R.W.R.)

52388 (LYCEN-7026) THE ELASTIC SCATTERING OF 28 MeV NEUTRONS BY DEUTERIUM. Gouanere, Michel (Lyon Univ. (France). Institut de Physique Nucleaire). Apr 1970. 120p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis.

A complex apparatus for studying n-d scattering at 28 MeV is described. The 28-MeV neutrons were produced from a 27-MeV deuteron beam by the $^{2}H(d,n)^{3}He$ reaction. The differential cross sections for elastic neutron-deuteron scattering were measured in a center-of-mass system for angles between 56 and 114° and 150 and 180°. The results obtained are in good agreement with those predicted by phase-shift analysis for p-d scattering at about the same energy, taking into account the Coulomb contribution. The neutron-deuteron system constitutes the simplest dynamic system which permits the study of a three-nucleon reaction without Coulomb forces. Theoretical calculations using the impulse approximation were compared with those using the Faddeev-Lovelace equations in the case of a separable potential in the s state. The results obtained using the dispersion relations are also given. (France)

52389 EVIDENCE FOR BROAD RESONANCES IN THE THREE-NUCLEON SYSTEM. Batty, C. J. (Rutherford High Energy Lab., Chilton, Eng.); Bonner, B. E.; Tschalaer, C.; Williams, L. E.; Clough, A. S.; Benoehr, H. C. pp 127-38 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

Continuum neutron spectra from (p,n) reactions on ^{3}H and ^{3}He were measured for proton energies of 30 and 50 MeV and neutron angles from 2 to 60°. Phase space distributions, normalized to the measured 60° spectra at 50 MeV, were subtracted at all angles. Evidence for a resonance centered at $Q \approx -16$ MeV and about 10 MeV wide was observed in both reactions. The $^{3}H(p,n)$ reaction exhibited evidence for an additional resonance at $Q \approx -9.5$ MeV with a width of about 6 MeV. This would indicate isospin values of $^{3}/_{2}$ and $^{1}/_{2}$ respectively for the two excitations. The angular distributions were in general agreement with a DWBA calculation with $\Delta L = 1$ angular momentum transfer. By means of a refined variational technique it was found that the Schrödinger wave function for the three-nucleon system exhibits a resonance-like behavior at approximately the right energies for the quantum numbers ($T = {}^{1}/_{2}$, $L = 1$, $S = {}^{3}/_{2}$) and ($T = {}^{3}/_{2}$, $L = 1$, $S = {}^{1}/_{2}$). The widths were also in general agreement with the data. This result does not depend critically on the P-wave part of the two-nucleon force. 12 references. (auth) (UK)

52390 ASYMMETRY MEASUREMENTS IN THE $^{2}H(p,2p)n$ REACTION AT 10.5 AND 24 MeV. Arvieux, J. (Institut des Sciences Nucleaires, Grenoble, France); Durand, J. L.; Papineau, A.; Tarrats, A. pp 212-29 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

The cross-section asymmetry for the coplanar breakup reaction $^{2}H(p,2p)n$ was measured using polarized protons of 10.5 and 24 MeV. At 10.5 MeV the neutron spectator mechanism at $\theta_1 = 30°$, $\theta_2 = -30°$ was studied. The cross section exhibited a smooth peak having a maximum corresponding to a minimum energy of the undetected neutron. The cross section is being fitted with the Kuckes-Wilson-Cooper theory of the spectator mechanism, which gives an absolute value too high by a factor of 2. At 10.5 and 24 MeV the experiment was focused on to the final-state interaction (FSI) between one proton and a neutron leading to the virtual singlet deuteron. The asymmetry was measured for various angles and found to be always negative in the n-p peak, where it reached -0.10 ± 0.038 at 24 MeV for the $\theta_1 = 35°$, $\theta_2 = -75°$ measurement. It is compared to the polarization in elastic scattering of protons by real triplet deuterons. The feasibility of deducing doublet ($S = {}^{1}/_{2}$) amplitudes for p-d scattering from FSI measurements in the $^{2}H(p,2p)n$ reaction, is discussed. (21 references) (auth) (UK)

52391 FINAL STATE INTERACTION SPECTRA OF MIRROR REACTIONS AND THE $^{1}S_0$ NEUTRON-NEUTRON SCATTERING PARAMETERS. Slobodrian, R. J. (Laval Univ., Quebec. Univ. of California, Berkeley); Meiner, H.; Ernst, J.; McKee, J. S. C.; Conzett, H. E.; Bacher, A. D.; Resmini, F. G. pp 390-7 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

The spectra of the mirror reactions $T(d,^{3}He)2n$ and $^{3}He(d,t)2p$ were measured with high statistical accuracy near 30 MeV. Although these reactions proceed mainly through a direct nucleon transfer mechanism and may be classified as short range reactions, the accurate $^{3}He(d,t)2p$ spectra show some departures from the simple Watson-Migdal theory. Lacking a rigorous three-body theory, a modification was used introducing a phenomenological form factor, obtained from the $^{3}He(d,t)2p$ reaction, for the interpretation of the spectra from the $T(d,^{3}He)2n$ reaction. The spectra were measured over a considerable energy range and show that both reactions are very symmetrical. Moreover, effects other than those of the nucleon-nucleon pole are small over the relevant region of the spectrum, and the procedure followed in the analysis thus stands on a reasonable empirical basis. Preliminary values of the scattering length are $a_n = -16.45 \pm 1.00$ fm and of the effective range $r_n = 3.1 \pm 0.5$ fm, where the errors reflect the correlation between r_n and a_n. If t_n is assumed fixed the error of a_n would be ± 0.45 fm. Some remaining uncertainties in the analysis may result in an increase of a_n by 0.3 fm and of t_n by 0.1 fm. 9 references. (auth) (UK)

52392 STUDY OF THE ENERGY DEPENDENCE OF THE p-p QUASI-FREE SCATTERING IN THE REACTION D(p,2p)n. Braithwaite, W. J. (Univ. of Washington, Seattle); Cameron, J. M.; Storm, D. W.; Margaziotis, D. J.; Paic, G.; Rogers, J. G.; Verba, J. W.; Young, J. C. pp 407-13 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

Kinematically complete experiments on the p + d interaction at low energies ($E_p \simeq 10$ MeV) have been reported. The data exhibit distinct enhancements in the kinematical region corresponding to the emission of two protons with high relative energy and a low energy neutron, implying a quasi-free scattering process. The results are somewhat unexpected at such a low incident energy, in view of the criteria for quasi-free scattering. For this reason it is intended to study the dependence of the enhancements on incident proton energy. The study will concentrate on the shape and position of the quasi-free peak and the energy variation of the cross section with energy will be compared to that of free p-p scattering. Some preliminary results are reported obtained from measurements in which the two emerging protons were detected at $\theta_1 = \theta_2 = 43°$ and $\phi_1 - \phi_2 = 180°$. The measurements at $E_{inc} = 14$, 17 and 20 MeV were made with the three-stage Van de Graaff accelerator at the University of Washington, and those at $E_{inc} = 36$, 41 and 46 MeV were made with the UCLA sector focusing cyclotron. 9 references. (auth) (UK)

52393 MEASUREMENT OF THE REACTIONS $^{4}He(p,pt)p$ AND $^{4}He(p,p^{3}He)n$ AT 46 MeV. Rogers, J. G.; Paic, G.; Epstein, M. B.; Verba, J. W.; Richardson, J. Reginald (Univ. of California, Los Angeles). pp 414-22 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

A correlation measurement was performed at different sets of angles by detecting protons in coincidence with tritons. It was found that pp and np final state interactions caused strong enhancement in the regions of low nucleon-nucleon relative energy. Energy spectra also exhibited strong enhancements in regions corresponding to p-T relative energies in the vicinity of the

position of the known excited states of ^{4}He. Results of a Plane Wave Born Approximation analysis of the nucleon-nucleon final state interaction enhancements are presented. The data are in agreement with the low energy nucleon-nucleon scattering parameters. Agreement of theory and data can be achieved without the introduction of a matrix element representing a simultaneous break-up mode. This feature seems to indicate that in this case this term is either very small or absent. The resonances observed in the p – T and n – ^{3}He interactions may be associated with the levels observed in two-body type reactions like elastic nucleon-trion scattering and the T(p,n)^{3}He reactions. No evidence for resonances above 25 MeV in the ^{4}He system was found. 8 references. (auth) (UK)

52394 THREE-BODY FINAL STATE IN THE D(d,n)pd REACTION. Birchall, J. (Birmingham Univ., Eng.); Blyth, C. O.; Dunscombe, P. B.; Mahtaboally, S. Q. G.; McKee, J. S. C.; Reece, B. L.; Slobodrian, M.; Slobodrian, R. J. pp 423-9 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

The energy spectra of neutrons from the reaction D(d,n)pd emitted at laboratory angles of 30°, 45° and 60° were studied using a time-of-flight technique. The incident deuterons were of 12.3 MeV energy. Timing resolution was unfolded from the high statistics spectra, which were then corrected for variation in detection efficiency. Absolute cross sections were deduced by comparison with the known two-body spectra from the D(d,n)^{3}He reaction. The break-up spectra, although simple in character, were known from the work of Rybakov et al. (Nucl. Phys. 23: 491(1961)) to depart from a purely statistical phase space form at slightly higher energy. Attempts to fit the present data with phase space plus an additional S-wave p-d interaction are being carried out. The end point energies (between 3 and 6 MeV) are thought to be low enough to make such an analysis worthwhile. The 45° data corresponding to an end point energy of 5 MeV were found to show little departure from phase space, and analysis of the higher energy 30° data is in progress. In addition, the possibility of higher angular momentum states being involved is being investigated using the prescription of Delves (Nucl. Phys. 20: 275(1960)). It is already clear that it will be possible to fit the three-body final state in the D(d,pd)n reaction with a combination of such states, if a departure from phase space is observed in the 30° data. 5 references. (auth) (UK)

52395 THE D(p,2p) REACTION AT 150 MeV. L'Huillier, M.; Marty, N.; Morlet, M.; Tatischeff, B.; Willis, A. (Institut de Physique Nucleaire, Orsay, France). pp 430-5 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

The results of a D(p,2p)n experiment done under a large range of kinematical conditions for low momenta of the neutron in D are briefly reported. Two different approximation methods which take into account all double scattering terms give a general agreement with the absolute values and trend of the differential cross sections. A more quantitative agreement needs more elaborate calculations. (auth) (UK)

52396 NEUTRON INDUCED NON-ELASTIC PROCESSES ON LIGHT NUCLEI. Valkovic, V.; Furic, M.; Miljanic, D.; Tomas, P. (Institut Rudjer Boskovic, Zagreb). pp 436-47 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

A summary of the experimental data on neutron induced break-up processes on light nuclei shows that most of the data have been obtained from kinematically incomplete measurements, and the inadequacies of the theoretical analyses of these data have been pointed out. Data on kinematically complete measurements on neutron induced non-elastic processes are very scarce. No measurements of the n-p bremsstrahlung at lower bombarding energies have been reported, and there are no correlation measurements from the break-up of helium nuclei induced by neutrons. New experimental techniques for neutron–charged particle and charged particle–charged particle coincidence measurements in the study of nuclear reactions induced by neutrons have, however, been developed, and it has been shown that measurements of neutron induced bremsstrahlung and break-up processes are feasible using an elaborate system of telescopic and other counters, fast electronics, time-of-flight techniques and multidimensional analysers. The importance of the determination of the neutron-proton bremsstrahlung cross section has been recognized, and it seems obvious that a study of the n + p → n + p + γ process might give valuable information about the nucleon-nucleon potential. The experiment described resulted in the determination of the upper limit for the n-p bremsstrahlung cross section for 14 MeV neutrons. From an analysis of the p + d → p + p + n reaction it was concluded that a reasonable value for the neutron-neutron scattering length might be obtained from a coincidence study of the n + d → n + p + n reaction, and preliminary data are reported indicating such a possibility. An attempt to measure proton-deuteron coincidence spectra in the ^{3}He(n,pd)n reaction was undertaken to obtain information about the reaction mechanism and spectroscopic information about mass two and three systems. 8 references. (auth) (UK)

52397 PICK-UP IN THE ^{6}Li(^{3}He,pα)^{4}He SEQUENTIAL REACTION. Deutchman, P. A. (Univ. of Idaho, Moscow). Lett. Nuovo Cim.; 4: 61-4(11 Jul 1970).

The DWBA is used to describe the neutron pickup in the sequential reaction ^{6}Li(^{3}He,pα)^{4}He under the assumption that the reaction is of the direct–delayed type in which a metastable intermediate state of ^{5}Li is formed. The statistical model predicts a nearly isotropic angular distribution for the first emitted α particle, in disagreement with the data at 1 MeV. A zero-range, local interaction was assumed; and the Woods–Saxon potential was used to generate the initial- and final-state distorted waves. Real and imaginary form factors were kept the same, and spin-orbit terms were omitted. The radius parameter used was 2.24 F in the initial state and 2.40 F in the final state. The results of the DWBA calculation decrease with angle. (R.W.R.)

52398 REACTIONS ^{4}He(p,tp)p AND ^{4}He(p,^{3}Hep)n AT E_p = 47 MeV. Rogers, J. G.; Paic, G.; Richardson, J. Reginald; Verba, J. W. (Univ. of California, Los Angeles). Phys. Rev., C; 2: 828-41(Sep 1970).

The three-body breakup reactions induced by 47-MeV protons on a gaseous ^{4}He target were investigated in a kinematically complete experiment. Protons were observed in coincidence with tritons or ^{3}He's at several pairs of coplanar lab angles using two counter telescopes. Data were stored by an on-line computer, which serially listed four linear signals from each event on magnetic tape. The proton spectra showed strong enhancements from neutron–proton and proton–proton final-state interactions, in agreement with the predictions of the Watson–Migdal theory. A Chew–Low-type extrapolation procedure was used to extract the np singlet scattering length, which was in fair agreement with the value from np free scattering. The triton and ^{3}He spectra showed peaks due to sequential reaction processes via the continuum resonance states in the ^{4}He system. These enhancements could be identified with previously observed ^{4}He levels of known spin and parity assignments. (auth)

52399 A-^{4}He SCATTERING AT LOW ENERGY. Gibson, B. F. (National Bureau of Standards, Washington, D. C.); Weiss, M. S. Phys. Rev., C; 2: 865-71(Sep 1970).

The elastic scattering of the A particle by ^{4}He was studied in the 0.1- to 10.0-MeV energy range. The calculation was performed using baryon–baryon interactions composed of central potentials previously employed in binding-energy calculations of $^5_\Lambda$He and a derivative spin-orbit A-^{4}He potential. Phase shifts, total cross sections, angular distributions, and polarizations were computed as functions of energy for l = 0, 1, and 2. The results are sensitive to the potential parameters, implying that even simple measurements would yield interesting information. (auth)

52400 SPIN-ISOSPIN FORMALISM FOR MULTIPLE SCATTERING OF PIONS. Dean, N. W. (Vanderbilt Univ., Nashville); Friar, J. L. Nucl. Phys.; B19: 301-22(1970).

The scattering of pions by composite particles, including effects of spin and isospin, is considered, using the Glauber formalism. The spin-isospin terms produce the group SU(4) in the scattering amplitude, which must be treated in the supermultiplet basis. Expressions are derived for pion scattering by light nuclei in terms of the pion-nucleon amplitudes, considering in particular the deuteron, ^{3}He and ^{4}He. An application is also made to multiple scattering in the quark model. (auth)

52401 CHOU–YANG MODEL, CURRENT–CURRENT INTERACTION, AND NUCLEON NUCLEON SCATTERING. Lo, S. Y. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Phys.; B19: 286-300(1970).

The Chou-Yang model is reformulated in the form of a current–current interaction picture. The implications of the new form are: (i) There would be considerable structure in the polarization parameters R, A, R′ and A′ even at the infinite energy limit. (ii) There would be dips but not zeroes in the asymptotic pp cross section. (iii) The energy dependent total

cross section dσ/dt and the polarization of pp scattering agree quite well with experimental data. (iv) The anomaly of the small slope of np charge exchange as compared with the elastic scattering is naturally explained. (v) The polarization of np → np elastic scattering is predicted to be negative to that of pp → pp scattering. (auth)

52402 180° ELECTRON SCATTERING FROM ^{3}He AND ^{4}He. Chertok, B. T. (American Univ., Washington, D. C.); Jones, E. C.; Bendel, W. L.; Fagg, L. W.; Kaiser, H. F.; Numrich, S. K. pp 60-2 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Measurements were made for 180° electron scattering from ^{3}He and ^{4}He at an electron energy of 56 MeV. A preliminary analysis of the ^{3}He data indicates that the threshold for the ^{3}He(e,e')dp reaction occurs at 6.0 MeV excitation. The cross section for ^{3}He electrodisintegration is about 2.7×10^{-33} cm^2/sr-MeV at 9 MeV excitation. The ^{4}He electroexcitation was observed as a smooth continuum rising from 21 MeV to a plateau between 24 to 27 MeV excitation. The cross section in this region is approximately 3.5×10^{-33} cm^2/sr-MeV. (J.W.R.)

52403 PHOTODISINTEGRATION OF HELIUM NUCLEI AT HIGH ENERGY. Picozza, P. (CNEN, Frascati, Italy); Schaerf, C.; Scrimaglio, R.; Goggi, G.; Piazzoli, A.; Scannicchio, D. pp 101-3 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The differential cross sections for the reactions ^{3}He(γ,p)d and ^{4}He(γ,p)t were measured at 90° in the center-of-mass system for photon energies between 200 and 500 MeV. The data are compared with other experimental results and with theoretical predictions. (J.W.R.)

52404 SPECTRA OF LIGHTEST NUCLEI KNOCKED OUT FROM LIGHT NUCLEI WITH 670 MeV PROTONS AND THE CLUSTERING PHENOMENON. Dzhelepov, V. P. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 278-87 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Two experiments on cluster behavior in nuclei are described. In the first, the momentum spectra for deuterons emitted at a laboratory angle of 6.5° and with momentum greater than 700 MeV/c when 670-MeV protons interacted with H, D, ^{7}Li, ^{12}C, ^{27}Al, ^{64}Cu, ^{103}Rh, and ^{208}Pb were measured. In the second experiment, the yields of ^{3}He and ^{4}He knocked out from ^{6}Li, ^{9}Be, ^{12}C, and ^{16}O at 500 MeV were determined. All the observed results give evidence for the peripheral character of the reactions. (J.W.R.)

52405 QUASI-ELASTIC REACTIONS WITH 600 MeV PROTONS. Perdrisat, C. F. (Coll. of William and Mary, Williamsburg, Va.); Swenson, L. W.; Gugelot, P. C.; Boschitz, E. T.; Roberts, W. K.; Vincent, J. S.; Priest, J. R. pp 326-8 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The differential cross sections for (p,2p) reactions on D and ^{4}He were measured. The outgoing protons were detected in coincidence with identical range telescopes. The Fermi momentum distributions were calculated from the data using the plane wave impulse approximation. (J.W.R.)

52406 ABSORPTION OF POSITIVE PIONS BY DEUTERON. Lazard, C. (Institut de Physique Nucleaire, Orsay, France); Ballot, J. L.; Becker, F. pp 452-4 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The total cross section, angular distribution, and polarization for absorption of positive pions by deuterons were calculated considering only s- and p-wave incident pions and also considering all partial waves. Better results were obtained by considering all partial waves. (J.W.R.)

52407 CHARGED PARTICLE EMISSION FOLLOWING PION CAPTURE IN NUCLEI. Coulson, L.; Minehart, R. C.; Ziock, K. (Univ. of Virginia, Charlottesville). pp 535-7 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A negative pion beam was stopped in thin targets of ^{7}Li, ^{12}C, and ^{27}Al. The protons, deuterons, and tritons emitted following pion capture were identified by radius of curvature in a bending magnet and by range in a 28-gap range chamber. Particle trajectories were determined in four sonic spark chambers. In addition, the particle spectra from pion capture in ^{4}He in the target atmospheres were measured. (J.W.R.)

52408 CORRELATION EFFECTS IN THE α-PARTICLE. Aguilera-Navarro, V. C.; Moshinsky, M. (Univ., Mexico, Mexico City). Phys. Lett.; 32B: 336-8(3 Aug 1970).

The binding energy of the α-particle is determined for a Tang soft-core potential. The trial wave function used is a linear combination of symmetric translationally invariant harmonic-oscillator states of J = 0 for up to ten quanta. The ground state is then used to discuss the correlation probability of finding pairs of nucleons inside the repulsive core as a function of the number of quanta in the approximation. (auth)

52409 ELECTRON SCATTERING SUM RULE FOR ^{2}H, ^{3}H, ^{3}He, AND ^{4}He. O'Connell, J. S. (National Bureau of Standards, Washington, D. C.). Phys. Lett.; 32B: 323-5(3 Aug 1970).

A sum rule is derived for the spatially symmetric part of the 1s shell nuclei. The result depends on the mean square momentum in the ground state, the nucleon pair correlation form factor and, for the helium isotopes, a momentum pair correlation form factor. (auth)

52410 PION–DEUTERON ELASTIC SCATTERING AT INTERMEDIATE ENERGIES. Carlson, Carl (Stanford Univ., Calif.). Phys. Rev., C; 2: 1224-32(Oct 1970).

Pion–deuteron elastic scattering was calculated via the impulse approximation (including double scattering) at intermediate energies. Good agreement was found with experiment at 87-, 142-, and 180-MeV/c^2 incident pion energy. Thus the impulse approximation seems to give reliable results even in the region of a large resonance. (auth)

52411 POLARIZATION IN ELASTIC NUCLEON–DEUTERON SCATTERING. Krauss, J.; Kowalski, K. L. (Case Western Reserve Univ., Cleveland). Phys. Rev., C; 2: 1319-28 (Oct 1970).

An approximate K-matrix calculation of elastic nucleon–deuteron scattering was carried out including the effects of two-nucleon tensor forces. The results of these computations, in the energy range from 11 to 40 MeV, are in reasonable agreement with the experimental nucleon polarizations and differential cross sections. (auth)

52412 ASYMMETRIC NEUTRON–PROTON BREMSSTRAHLUNG AT 208 MeV. Brady, F. P.; Young, J. C. (Univ. of California, Davis). Phys. Rev., C; 2: 1579(Oct 1970).

Additional data on neutron–proton bremsstrahlung measurements at 208-MeV neutron energy are presented. These are at (θ_n,θ_p) = (40°,30°) and (45°,30°). Also, the analysis of the symmetric-angle data reported earlier was improved resulting in small changes in the cross sections. (auth)

52413 POLARIZATION TRANSFER IN THE REACTION T(d,n)^{4}He AT 0° FROM 3.9 TO 15 MeV. Broste, W. B.; Lawrence, George P.; McKibben, Joseph L.; Ohlsen, Gerald G.; Simmons, J. E. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Lett.; 25: 1040-2(12 Oct 1970).

Measurements of neutron polarization are reported for the reaction T(d,n)^{4}He at 0° in which the incident beam is polarized with quantization axis perpendicular to the direction of motion. The beam polarization was described by $p_3 = p_{33} \approx 0.76$, while beam intensities varied from 10 to 40 nA. At E_d = 15 MeV the neutron polarization was measured to be +0.56 ± 0.036 with respect to the quantization axis. At 3.9 MeV the polarization was zero, showing the influence of spin-flip interactions from the low-energy $^5S_2$ resonance. The measurements are related to polarization transfer and efficiency tensor functions for the reaction. (auth)

Nuclear Properties and Reactions, 6≤A≤19

Refer also to abstracts 51919, 52113, 52135, 52149, 52404, 52407, 52471, 52474, 52479, 52539, 52546, 52563, 52566, 52717, 52732, and 52735.

52414 (CEA-R-3969) CONTRIBUTION TO THE STUDY OF THE THREE BODY REACTION $^{11}B(p,3\alpha)$. Giorni, Alain (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Jun 1970. 93p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Grenoble Univ., France.

The spectra of the $^{11}B(p,3\alpha)$ reaction were measured with a two-parameter spectrometer, at proton energies of 680 keV, 1.4 and 2 MeV, corresponding to the 2^-, 1^- and 0^+ levels of ^{12}C. The spectra were compared with a calculation in which the total amplitude is written $T = \tau + T\,G_0\,\tau$ for the reaction $B^{11} + p \rightarrow \alpha_1 + \alpha_2 + \alpha_3$, with $G_0 = (E - H_0 + i\,\epsilon)^{-1}$. The operator τ corresponds to the production of three uncorrelated α particles; the operator $T = T_1 + T_2 + T_3$, $[T_i = t_i + t_i\,G_0\,(T_j + T_k)]$, describing the 3α particle interaction is given by the Faddeev equations. The properties of the 3α system were studied by an analysis of the angular momentum and after symmetrization. The numerical calculations were made with the final state interaction approximation, i.e. $T_i \approx t_i$, where t is the two body $\alpha\alpha$ amplitude given by the well known phase-shifts δ_0 and δ_2. The neglected terms were estimated by a complex constant. The resonant form of the excitation curve $^{11}B(p,3\alpha)$ suggested an appropriate description of the matrix elements to be given by a Breit–Wigner formula: $\langle f\,|\tau|\,i\rangle = G_i G_f/(E - E_0 + i\,\tau_0/2)$; for each ^{12}C level, the influence of the other resonances was neglected. The calculation gives a good description of the Dalitz-plot (except for the 0^+ level of ^{12}C), assuming that the contribution of the direct production term is negligible compared to the $\alpha\alpha$ interaction terms. (auth) (France)

52415 (INSJ–122) QUASI-FREE ELECTRON SCATTERING ON ^{12}C AND ^9Be. Hiramatsu, S.; Kamae, T.; Muramatsu, H.; Nakamura, K.; Nishiyama, K.; Shimizu, Y.; Kabe, S. (Tokyo Univ. (Japan). Inst. for Nuclear Study). 14 Jul 1970. 45p. Dep. CFSTI (U. S. Sales Only).

A preliminary run testing the feasibility of quasi-free electron scattering experiments for light and medium nuclei was carried out using the external electron beam at the Institute for Nuclear Study. The binding energy spectra for ^{12}C and ^9Be and the momentum distributions of 1s and 1p protons in ^{12}C and of 1p protons in ^9Be are presented. A short review of impulse approximations as applied to the quasi-free electron scattering is also included. The results agree well with that obtained by Amaldi, et al. for ^{12}C. However, for ^9Be, they agree only poorly with (p, 2p) results. (auth)

52416 (NP–18387) TENSOR POLARIZATION AND REACTIONS OF DEUTERONS ON ^{12}C AND ^{16}O. Cords, Hartmut (Australian National Univ., Canberra). Jul 1969. 171p. Dep. CFSTI (U. S. Sales Only).

Thesis.

Deuteron tensor polarization was measured for ^{12}C at 3.5 to 7.1 MeV at 22.5 to 75° and for ^{16}O at 6.34 MeV at 15.3 to 88.8° lab, and an optical-model analysis of the results was made. In addition, excitation functions and angular distributions were measured for the following cases: deuteron elastic and inelastic scattering on ^{12}C at 5 to 10 MeV from 20 to 160°; deuteron elastic scattering at 4.4 to 8.4 MeV between 20 and 140°; deuteron reactions (d,p) and (d,α) at 5 to 10 MeV from 20 to 160°; and deuteron reactions (d,p) and (d,α) at 4.4 to 8.4 MeV between 20 and 140°. Optical-model and DWBA analyses were done with the Hauser–Feshbach formalism to account for the compound nucleus contribution. The measurements of the tensor polarization enabled a more comprehensive appraisal of optical potential components and the participating reaction mechanisms. The three deuteron optical potentials obtained from the analyses were not notably different. (R.W.R.)

52417 SEARCH FOR EXCITED LEVELS IN ^3He. Bray, K. H.; Jayaraman, K. S.; Moss, G. A.; Tivin, P. J.; van Oers, W. T. H.; Wells, D. O.; Wu, Y. I. (Univ. of Manitoba, Winnipeg, Can.). pp 139–53 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

Using the University of Manitoba sector-focused cyclotron a search was made for excited states in ^3He. The investigation consisted of two parts. In the first, a kinematically incomplete experiment, the ^3He and alpha-particle continua from the $^6Li(p,^3He)$ and $^6Li(p,\alpha)$ reactions at an incident proton energy of 45.0 MeV were studied for structure due to excited states in ^4He and ^3He respectively. The ^3He and alpha-particle spectra were observed from 15 to 90° in steps of 5° using a Δ E-E detector telescope. The ^3He spectra showed clearly discernible peaks due to the 20.2 and 21.4 MeV excited states in ^4He. In the alpha-particle spectra no structure was observed that could be interpreted as due to excited states in ^3He for excitation energies up to 17.5 MeV. A comparison between the ^3He and alpha-particle continua at 25° gave an upper limit of 50 μb/sr for the excitation of states in ^3He having a width of 0.5 MeV. In the second part, a kinematically complete experiment, a study was made of the coincidence spectra from the $^6Li(\vec{p},\alpha d)p$ reaction at an incident proton energy of 45.0 MeV. The alpha-particle detector was set at 50° while the deuteron detector telescope was moved from −90 to −50° in steps of 10°. The measured coincidence spectra showed a prominent p–α final-state interaction corresponding to the ground state of ^5Li. No proton-deuteron final-state interaction corresponding to $T = \frac{1}{2}$ levels in the ^3He system between 5.5 and 12 MeV was observed. The measurements are being extended to include pairs of angles where kinematically it is impossible to observe the well known p–α and d–α final-state interactions. The results of the present and other experiments are discussed. 33 references. (auth) (UK)

52418 α–α INTERACTION IN THE $^8_\Lambda Be \rightarrow \alpha + \alpha + p + \pi^-$ DECAY. Chlebowska, D.; Wrzecionko, J.; Zielinska-Pfabe, M. (Inst. of Nuclear Research, Warsaw). Phys. Lett.; 32B: 177-8 (22 Jun 1970).

The α-particle energy distribution is calculated for the $^8_\Lambda Be \rightarrow \alpha + \alpha + p + \pi^-$ decay. The $\alpha - \alpha$ final-state interaction described by the Gaussian and Coulomb potential is treated exactly. The narrow peak at 0.095 MeV which clearly corresponds to the 0^+ ground state of ^8Be is obtained. (auth)

52419 HIGH-ENERGY PHOTODISINTEGRATION OF LITHIUM. Sanzone, M. (Univ., Genoa); Ricco, G.; Costa, S.; Ferrero, L. Nucl. Phys.; A153: 401-8(1970).

The spectra of fast photoprotons from the reaction $^7Li(\gamma,p)^6He$ have been measured at 14 bremsstrahlung end-point energies from 50 to 84 MeV. The observed kinematical behavior and the comparison of the measured cross sections with the theory shows that the threshold photoprotons are emitted through a direct interaction of the photon with the 1p proton, while a quasi-deuteron absorption is probably mostly responsible for the emission of lower-energy protons. (auth)

52420 (^3He,^6He) REACTION ON ^6Li AND ^7Li. Bacher, A. D.; McGrath, R. L.; Cerny, J.; de Swiniarski, R.; Hardy, J. C.; Slobodrian, R. L. (Univ. of California, Berkeley). Nucl. Phys.; A153: 409-12(1970).

Energy spectra of ^6He from the reactions $^6Li(^3He,^6He)3p$ and $^7Li(^3He,^6He)^4Li$ have been measured at 14.1° for a ^3He bombarding energy of 53.2 MeV. No evidence is found either for a $T = \frac{3}{2}$ state in the triproton system or for a $T = 2$ state in ^4Li. (auth)

52421 $^{18}O(^3He,n)^{20}Ne$ AND $^7Li(^3He,n)^9B$ REACTIONS. Gul, K. (Oxford Univ.); Armitage, B. H.; Hooton, B. W. Nucl. Phys.; A153: 390-400(1970).

Information on the level structure of ^{20}Ne and ^9B has been obtained from the $^{18}O(^3He,n)^{20}Ne$ and $^7Li(^3He,n)^9B$ reactions at $E(^3He) = 3.1$ MeV. The time-of-flight technique was used to obtain neutron spectra and angular distributions were measured from 0° to 140°. The angular distributions were analyzed using DWBA two-particle stripping theory and two new states in ^{20}Ne at 12.41 and 13.10 MeV were strongly excited and tentatively identified as 0^+. A group corresponding in position to a state in ^9B at 1.5 MeV, in a 90° measurement at an incident energy of 3.1 MeV, was attributed to the decay of the 11.82 MeV state in ^9Be. Groups in the neutron spectrum leading to the ground state of ^9Be, an unresolved doublet at about 2.5 MeV and a level at 4.8 MeV were also observed. (auth)

52422 β^+ DECAY OF ^{16}Ne. Aslanides, E.; Jundt, F.; Gallmann, A. (Laboratoire de Physique nucleaire et d' Instrumentation Nucleaire, Strasbourg). Nucl. Phys.; A152: 251-6 (1970). (In French).

The positron decay of ^{16}Ne has been investigated using the $^{16}O(^3He,n)$ reaction with a natural oxygen gas target at bombarding energies between 10.0 and 11.0 MeV. The half-life $T_{\frac{1}{2}} = 1.69 \pm 0.04$ s has been determined for the ^{16}Ne decay which lies far outside the standard deviation of the previously reported values. The reduced matrix element for the Gamow-Teller transition to the ground state of ^{16}F, deduced from the results, $|\int\sigma|^2 = 1.11 \pm 0.04$, is in agreement with the matrix element of the analogue transition of ^{16}F to the ground state of ^{16}O. A previously unreported allowed transition, $0.17 \pm 0.05\%$, log ft = $4.52^{+0.11}_{-0.14}$, has been observed, feeding the second 1^+, $T = 0$ level of ^{16}F at 1701 keV. (auth)

52423 ^3He ELASTIC SCATTERING FROM ^{10}B AND ^{14}C IN THE RANGE 4 TO 18 MeV. Duggan, J. L. (Oak Ridge Associated Universities, Tenn.); Park, J. Y.; Danielopoulos, S. D.; Mil-

ler, P. D.; Lin, J.; Duncan, M. M.; Dangle, R. L. Nucl. Phys.; A151: 107-19(1970).

Differential cross sections for the ^{3}He elastic scattering from ^{10}B at 4, 8, 10, 12, 15 and 18 MeV and from ^{14}C at 10, 12, 15 and 18 MeV have been measured. A systematic analysis of the elastic scattering data in terms of the optical model with surface absorption and including the spin-orbit interaction has been carried out. In most cases reasonably good agreement with the data is obtained. Inclusion of spin-orbit coupling generally improves the fits. Various ambiguities are found and examined. The results are compared with those obtained in the previous analysis of ^{3}He scattering data from ^{11}B and ^{12}C. Isotope differences in the elastic scattering may be due to symmetry dependence of the ^{3}He optical potential. The variation of the optical-potential parameters with energy and mass is investigated. General trends of various parameters are observed and some fluctuations are seen. Effects of experimental uncertainty on the potential parameters deduced are also examined. Average energy-dependent potentials consisting of eight parameters were obtained for each nucleus in the energy range studied. (auth)

52424 DWBA CALCULATIONS OF ANGULAR DISTRIBUTIONS OF PROTONS FROM ^{11}B(d,p)^{12}B. Vogt, P.; Kamke, D. (Ruhr-Univ., Bochum, Ger.). Nucl. Phys.; A151: 1-15(1970). (In German).

25 angular distributions of the p_0 and p_1 groups from the reaction ^{11}B(d, p)^{12}B at E_d = 0.7 to 3.5 MeV have been investigated by DWBA calculations. Because of a lack of scattering data the theoretical stripping cross sections have been fitted directly to the experimental data. The best fit parameters obtained are comparable with those derived from scattering analyses of neighbouring nuclei and energies. The energy dependence of two parameters shows irregularities which may be due to energy levels in the compound nucleus ^{13}C. (auth)

52425 STUDY OF THE REACTIONS ^{16}O(d,p)^{17}O AND ^{90}Zr(d,p)^{91}Zr USING THE WBP MODEL. Pearson, C. A.; Zissermann, D.; Covan, J. M. (Univ. of Alabama, Birmingham). Nucl. Phys.; A152: 449-62(1970).

The weakly bound projectile model is tested against measurements of differential cross sections, vector analyzing power and polarization in the reactions ^{90}Zr(d, p)^{91}Zr and ^{16}O(d, p)^{17}O leading to states in the s- and d-shells at deuteron energies between 7 and 15 MeV. (auth)

52426 ^{9}Be(α,n)^{12}C CROSS SECTION BETWEEN 1.5 AND 7.8 MeV. van der Zwan, L.; Geiger, K. W. (National Research Council, Ottawa). Nucl. Phys.; A152: 481-94(1970).

Three neutron groups populating the 7.65 MeV, 4.44 MeV and the ground state of ^{12}C were separated by proton recoil detection in an organic scintillator. The 0° differential cross sections were measured in 0.1 MeV intervals between 1.5 and 7.8 MeV and angular distributions were determined at eight α-energies. For the ground state neutron group, angular distributions at eight additional energies were taken. Neutron production cross sections from the reaction were derived using these distributions and those of previous authors. Most of the angular distributions measured are asymmetric about 90°, showing various degrees of fore- and aft-peaking. It appears that compound nucleus formation in ^{13}C, involving several overlapping resonances, plays a dominant role in some cases. In others there is evidence for direct reaction processes. (auth)

52427 ELECTRON SCATTERING FROM LIGHT, DEFORMED, ORIENTED NUCLEI. Langworthy, J. (Naval Research Lab., Washington, D. C.); Ueberall, H. Phys. Rev., C; 2: 911-19(Sep 1970).

Electron scattering experiments from oriented nuclei were previously carried out for holmium. Scattering from light nuclei has the advantages that the elastic scattering is unencumbered by unresolved low-level excitations and that the small distortion of the electron wave function renders orientation effects relatively quite pronounced despite small quadrupole moments, thus permitting the use of the Born approximation. Assuming 100% alignment, large orientation effects were calculated for elastic and also for inelastic scattering from oriented ^{19}B, as well as for 180° magnetic elastic scattering; for more realistic alignments easily measurable effects are predicted. (auth)

52428 ELECTRON SCATTERING EXPERIMENTS AT THE MAINZ 300 MeV LINEAR ACCELERATOR. Andresen, H. G.; Averdung, H.; Ehrenberg, H.; (and others) (Univ., Mainz). pp 56-9 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Some experiments on electron elastic and inelastic scattering by ^{6}Li, ^{12}C, ^{24}Mg, ^{28}Si, and ^{32}S at electron energies of 100 to 300 MeV are reported. Elastic and inelastic cross sections and inelastic form factors are presented. Preliminary values of some level widths obtained in a Born approximation analysis are also presented. (J.W.R.)

52429 ANOMALOUS q-DEPENDANCE OF TRANSVERSE ELECTROMAGNETIC FORM FACTORS IN ^{12}C AND ^{9}Be. Beck, F.; Gruenbaum, L.; Tomaselli, M. (Technische Hochschule Darmstadt, Ger.). pp 63-6 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The particle-core coupling model was used to describe the low-lying positive-parity states of ^{12}C and ^{9}Be, and to study the q-dependence of inelastic form factors. The interaction matrix elements were calculated by taking the core states of ^{12}C and ^{9}Be in the L−S coupling limit and employing the usual fractional parentage expansion. The results are compared with experiment. (J.W.R.)

52430 SINGLE PARTICLE WAVEFUNCTIONS IN A NON-LOCAL POTENTIAL. Elton, L. R. B.; Webb, S. J.; Barrett, R. C. (Univ. of Surrey, Eng.). pp 67-73 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Electron-scattering data are analyzed in terms of an energy independent non-local potential. The potential was used to fit individual nuclei from ^{12}C to ^{208}Pb, and excellent agreement with experiment was obtained when the parameters were suitably chosen. Some results for ^{12}C, ^{40}Ca, ^{48}Ca, and ^{208}Pb are presented. (J.W.R.)

52431 SHORT-RANGE CORRELATIONS AND HIGH-ENERGY ELECTRON SCATTERING. Ciofi degli Atti, C.; Kabachnik, N. M. (Istituto Superiore di Sanita, Rome). pp 74-6 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The effect of short-range dynamical correlations on the charge form factor of ^{16}O was studied. The form factor was calculated with a Slater determinant composed of Woods−Saxon wave functions and with a harmonic oscillator potential including Jastrow correlations. The calculations using the Woods−Saxon well failed to fit the experimental data. (J.W.R.)

52432 ELECTRON SCATTERING FROM LIGHT DEFORMED ORIENTED NUCLEI. Langworthy, J.; Ueberall, H. (Naval Research Lab., Washington, D. C.). pp 80-2 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Elastic and inelastic electron scattering from several orientations of completely aligned ^{19}B, represented by harmonic oscillator and Tassie model fits of unoriented experimental data, is calculated and compared with scattering from the unoriented target. Results show large effects due to orientation. (auth)

52433 MESON EXCHANGE EFFECTS ON ELECTRON SCATTERING FORM FACTORS IN ^{12}C. Chemtob, Marc; Lumbroso, Albert (CEN de Saclay, Gif-sur-Yvette, France). pp 86-8 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A systematic study is made of electron scattering form factors for excitations in ^{12}C above 14 MeV considering the role of meson exchange currents. The model for the interaction currents consists in the non-covariant perturbation approach for extracting the non-relativistic Hamiltonian operators from the s-matrix. The results confirm that the exchange corrections to the form factors are generally small. (J.W.R.)

52434 GIANT AND PYGMY RESONANCES IN A = 3, 5, 11, 13, 15, AND 17 NUCLEI. Albert, D. J.; Wagner, R. F.; Ueberall, H.; Wernts, C. (Catholic Univ. of America, Washington, D. C.). pp 89-91 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Two particle–one hole shell model calculations were performed for the giant and pygmy resonance region of ^{13}C and ^{17}O. The electron scattering form factors for ^{13}C were also calculated for the resulting states. The results are illustrated. (J.W.R.)

52435 INELASTIC PHOTOPION PRODUCTION WITH EXCITATION OF GIANT RESONANCE ANALOGS: APPLICATION TO ^{16}O. Kelly, F. J.; McDonald, L. J.; Ueberall, H. (Naval Research Lab., Washington, D. C. Catholic Univ. of America, Washington, D. C.). pp 95-7 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A generalized Goldhaber–Teller model of the ^{16}O giant resonances was used to evaluate the differential cross section for the photoproduction of positive pions leading to giant resonance spin-flip states in ^{16}N. The pion spectra were calculated assuming monochromatic incident photons. A possible subsequent neutron emission was also considered. It was found that at forward angles of pion emission the spectra are dominated by dipole resonances, but that at larger angles the quadrupole resonances appear strongly, making it possible to experimentally identify the two types of resonances. (J.W.R.)

52436 NEUTRON ENERGY SPECTRA FROM NEGATIVE MUON ABSORPTION ON COMPLEX NUCLEI. Evseev, V.; Kozlowski, T.; Roganov, V.; Woitkowska, J. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 157-9 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Some measurements of neutron energy spectra from negative muon absorption in ^{16}O, ^{32}S, ^{40}Ca, and Pb are reported. The structures in the neutron spectra offer evidence on the capture mechanism and on the decay mechanism of the quasi-bound states. (J.W.R.)

52437 MUON CAPTURE AND NUCLEAR STRUCTURE. Morita, M. (Osaka Univ.); Ohtsubo, H.; Fujii, A. pp 180-1 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The phenomenological V–A theory of leptonic interactions was used to study the interaction $\mu^- + p \rightarrow n + \nu$. The calculated capture rates are in agreement with recent data for gaseous and molecular hydrogen. The muon capture rate for ^{12}C was calculated using general p-shell wave functions. The muon capture rate for ^{16}O was calculated using RPA and Tamm–Dancoff models. (J.W.R.)

52438 MEASUREMENTS OF (p,2p) REACTIONS AT 385 MeV. James, A. N. (Univ. of Liverpool). pp 297-304 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Measurements were made of the distorted momentum distributions for (p,2p) reactions on ^{12}C, ^{48}Ca, ^{45}Sc, ^{58}Co, ^{58}Ni, and ^{120}Sn at an incident proton energy of 385 MeV. The results were analyzed in terms of the distorted wave impulse approximation. The qualitative behavior of the single particle strengths as a function of binding energy was determined. (J.W.R.)

52439 (p,2p) REACTIONS AT 600 MeV. Cordaillat, A. (CERN, Geneva); Johansson, A.; Kullander, S.; Landaud, G.; Lemeilleur, F.; Renberg, P. U.; Tibell, G.; Yonnet, J. pp 305-9 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Some preliminary experimental results for (p,2p) reactions on ^{12}C and ^{40}Ca at an incident proton energy of 600 MeV are reported. The aim of the experiment is to obtain information on strongly bound protons. (J.W.R.)

52440 QUASI-ELASTIC (p,px) REACTIONS ON LITHIUM AND CARBON AT 156 MeV. Bachelier, D.; Brusel, M. K.; Radvanyi, P.; Roy, M.; Sowinski, M.; Bernas, M.; Brissaud, I. (Institut de Physique Nucleaire, Orsay, France). pp 318-20 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The ^6Li (p,p ^3He) and ^7Li (p,pt) reactions were studied at 156 MeV with kinematical conditions chosen so as to favor quasielastic scattering. The protons were detected in coincidence with the tritons and helium-3 particle. The p–x angular correlations were determined. (J.W.R.)

52441 π^- ABSORPTION ON SOME LIGHT NUCLEI. Calligaris, F.; Cernigoi, C.; Gabrielli, L.; Pellegrini, F. (Univ., Trieste, Italy. Istituto Nazionale di Fisica Nucleare, Trieste, Italy. Univ., Padua). pp 367-73 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Some experimental results concerning the absorption of negative pions by ^4He, ^6Li, ^9Be, and ^{12}C are presented. The energy spectra of particles from (π^-,np) and (π^-,nd) reactions on ^6Li, ^9Be, and ^{12}C and from (π^-,d2n), (π^-,tn) and (π^-,p3n) reactions on ^4He were measured at 120 MeV. (J.W.R.)

52442 RARE MODE NUCLEAR ABSORPTION OF PIONS. Gotow, Kazuo (Virginia Polytechnic Inst., Blacksburg). pp 374-81 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Two experiments on low-yield pion-nucleus processes are described. In the first, single proton emission following π^+ capture by ^{12}C at 73 MeV was studied. The energy spectra of protons emitted at 0° were measured, and the cross section was determined. In the second experiment, the neutrons emitted following radiative pion capture by ^{12}C, ^{16}O, and Ca were studied. The observed neutron spectra give evidence for the processes of quasi-free absorption and analog giant resonance excitation. (J.W.R.)

52443 EXPERIMENTAL STUDY OF MANY-BODY REACTIONS WITH ^8Li PRODUCTION IN SLOW NEGATIVE PION CAPTURE BY ^{12}C, ^{14}N, ^{16}O NUCLEI. Agababian, N. M. (Joint Inst. for Nuclear Research, Dubna, USSR); Batusov, Yu. A.; Bunyatov, S. A.; Chernev, Kh. M.; Cuer, P.; Massue, J.-P.; Sidorov, V. M.; Yarba, V. A. pp 449-51 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Photoemulsion chambers were used to study 3 prong events with ^8Li production resulting from pion capture by ^{12}C, ^{14}N, and ^{16}O. Relative probabilities were obtained for 15 different reactions. (J.W.R.)

52444 PROMPT GAMMA RAYS FROM π-BOMBARDMENT OF ^{12}C NEAR THE 3–3 RESONANCE. Lieb, J.; Funsten, H. (Coll. of William and Mary, Williamsburg). pp 458-60 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Preliminary data on prompt gamma rays from discrete nuclear levels from negative pion bombardment of ^{12}C are presented. Both Ge(Li) and NaI detectors were used. Pion energies of 100, 250, and 315 MeV were used. Some possible assignments of the γ rays are discussed. (J.W.R.)

52445 PRELIMINARY RESULTS ON INTERACTIONS OF LOW ENERGY PIONS ON CARBON NUCLEI. Belliotti, E.; Bonetti, S.; Fiorini, E.; Pullia, A.; Rollier, M. (Istituto di Fisica, Milan. INFN, Milan). pp 461-4 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Some preliminary data on the interactions of 0.25- to 2.0-GeV/c pions with carbon nuclei are presented. Cross sections were obtained for coherent scattering, incoherent interactions, and absorption. (J.W.R.)

52446 MEASUREMENTS OF KAONIC X-RAY SPECTRA AND THE CAPTURE OF KAONS ON NUCLEAR SURFACES. Wiegand, Clyde E. (Univ. of California, Berkeley). pp 502-11 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The x-ray spectra from kaonic atoms of 29 elements from Z = 3 to Z = 92 were measured using Ge(Li) detectors. The data were used to interpret properties of the nuclear surface. The results confirm that neutron nuclear matter extends to a larger radius than the radius of the nuclear charge distribution. (J.W.R.)

52447 NEUTRONS FROM RADIATIVE PION ABSORPTION ON ^{16}O AND ^{28}Si NUCLEI. Holland, M. M.; Minehart, R. C.; Sobottka, S. E. (Univ. of Virginia, Charlottesville). pp 538-40 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The energy spectra of neutrons and γ rays emitted following pion capture by ^{16}O and ^{28}Si were measured using plastic and liquid scintillators and a Cherenkov total absorption gamma detector. Indications of giant resonance structure were seen, but better statistics are needed before definite conclusions can be drawn. (J.W.R.)

52448 PARITY MIXING IN ^{16}O. Sprenkel-Segel, E. L. (Illinois Inst. of Tech., Chicago. Argonne National Lab., Ill.); Segel, R. E.; Siemssen, R. H. pp 763-5 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The alpha branch from the 8.88-MeV state in ^{16}O in the delayed alpha spectrum following the β decay of ^{16}N was studied using an improved experimental technique. The sensitivity of the measurement was at least an order of magnitude better than that of previous measurements. An alpha width of 1×10^{-9} eV was found corresponding to a parity impurity of $F^2 \approx 2 \times 10^{-13}$. This result is consistent with the cvc theory of weak interactions. (J.W.R.)

52449 STATES IN ^{14}O EXCITED BY THE $^{14}C(^7Li,t)$ REACTION. Morgan, G. L. (North Carolina State Univ., Raleigh. Triangle Universities Nuclear Lab., Durham, N. C.); Tilley, D. R.; Mitchell, G. E.; Hilko, R. A.; Roberson, N. R. Phys. Lett.; 32B: 853-5 (3 Aug 1970).

The reaction $^{14}C(^7Li,t)^{18}O$ was studied at 20.4 MeV bombarding energy. States in ^{18}O up to excitation energies of 12.5 MeV were observed. The data provide evidence that the 6^+ state at 11.69 MeV belongs to the ground state rotational band. (auth)

52450 OBSERVATION OF THE 13.42 MeV T = 3/2 STATE IN ^{15}N. Ramirez, J. J.; Weller, H. R.; Blue, R. A. (Univ. of Florida, Gainesville). Phys. Lett.; 32B: 361-3(3 Aug 1970).

Measurements were made of the $^{14}C(p,p)^{14}C$, $^{14}C(p,\alpha_0)^{11}B$, $^{14}C(p,n)^{14}N$ and $^{14}C(p,\gamma)^{15}N$ reactions in the region of the 13.42 MeV level in ^{15}N. Analysis of the elastic data gives a $3/2^+$ spin assignment to this level. This state is identified as the analog of the second excited state of ^{15}C. The results of a Nilsson model calculation are compared to the experimental results. (auth)

52451 OBSERVATION OF STRUCTURE IN THE SPECTRUM OF PIONS PRODUCED BY FERMI MOTION. Domingo, J. J. (Oxford Univ.); Allardyce, B. W.; Ingram, C. H. Q.; Rohlin, S.; Tanner, N. W.; Rohlin, J.; Rimmer, E. M.; Jones, G.; Girardeau-Montaut, J. P. Phys. Lett.; 32B: 309-12(3 Aug 1970).

Differential ground state capture cross sections were measured at 0^0 and T = 600 MeV for the reactions $^{12}C(p,\pi^+)^{13}C$, $^{13}C(p,\pi^+)^{14}C$, and $^{14}N(p,\pi^+)^{15}N$. The magnitude of these cross sections, about 0.5 μb/sr exceeds, by a factor of 100, estimates made using harmonic oscillator wave functions. (auth)

52452 COMMENTS ON THE ALPHA-PARTICLE MODEL OF ^{12}C AND ^{16}O. McDonald, L. J. (Catholic Univ. of America, Washington, D. C.); Ueberall, H.; Numrich, Susan. Nucl. Phys.; A147: 541-4(1970).

It is noted that the simple α-particle model of ^{12}C and ^{16}O, when applied to recent electron scattering data for these nuclei which greatly extend the region of momentum transfer, still provides a partially satisfactory fit. In particular, for elastic scattering by ^{16}O, the model also predicts the recently observed second diffraction minimum which so far could be explained by more detailed theoretical models only. (auth)

52453 (^3He,^7Be) REACTION ON LIGHT NUCLEI. Detraz, C.; Duhm, H. H.; Hafner, H. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys.; A147: 488-508(1970).

An experimental study of the (^3He,^7Be) reaction was performed at 30 MeV with ^{10}B, ^{12}C, ^{16}O, ^{19}F, ^{20}Ne, ^{28}Si, and ^{40}Ca target nuclei. The doublet arising from the occurrence of two bound states of the ^7Be nucleus, the $^7Be_{(0)}$ $3/2^-$ ground state, and the $^7Be_{(1)}$ $1/2^-$ first excited state, was resolved in all the spectra. Angular distributions up to about 90° or more in the cms are presented for the strongest transitions. A mechanism of one-step pick-up of four correlated nucleons, with the internal quantum numbers of a free α-particle, in short α-pick-up, is consistent with the main characteristics of the data. Unambiguous experimental evidence, though, calls for at least a partial correction to this simplified picture: the angular distributions of $^7Be_{(0)}$ and $^7Be_{(1)}$ are found to be somewhat different, and the shapes of the angular distributions vary rather quickly with the incident energy. The nature and validity of the assumptions of an α-pick-up mechanism are discussed, and tentative DWBA fits to the data are obtained with a "fixed range" interaction approximation. The main spectroscopic information is that the α-transfer spectroscopic factor does not decrease between ^{12}C and ^{40}Ca nearly as strongly as shell-model wave functions would suggest. (auth)

52454 SCATTERING OF 14.1 MeV NEUTRONS FROM ^{11}B. Alder, J. C.; Vaucher, B. (Univ., Lausanne, Switzerland). Nucl. Phys.; A147: 657-72(1970).

Angular distributions of the differential cross sections and integrated cross sections for the scattering of 14.1 MeV neutrons from ^{11}B for the 0, 2.12, 4.44, 5.02, (6.74 + 6.79) and 7.30 MeV levels have been measured. Two targets (81.17% ^{11}B, 18.83% ^{10}B (natural boron) and 91.35% ^{10}B, 8.65% ^{11}B) were used. A Monte Carlo program, which calculated the time-of-flight spectra for the two targets, was used to obtain the best value of the cross sections. The elastic scattering has been analyzed with the optical model. Differential cross sections for the four lower excited states show some discrepancies with respect to the predictions of the excited-core model ($^{12}C(0^+ \rightarrow 2^+)$ + $1p_{\frac{3}{2}}$ hole) and collective DWBA calculations. However, they agree well with those derived from the unified model of ^{11}B, which takes into account the strong coupling scheme for these levels by assuming a $1p_{\frac{3}{2}} \rightarrow 1p_{\frac{1}{2}}$ hole transition superimposed on collective excitations. On the basis of this model, the spin of the 5.02 MeV level is found to be $3/2$. (auth)

52455 HOLE STATES IN ^{19}Ne. Garrett, J. D.; Middleton, R.; Fortune, H. T. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., C; 2: 1243-54(Oct 1970).

Levels of ^{19}Ne below an excitation energy of 7 MeV were investigated using the $^{20}Ne(^3He,\alpha)^{19}Ne$ reaction at a bombarding energy of 15 MeV. Previously unreported states of ^{19}Ne were observed at excitation energies of 4.200, 4.625, 4.783, 5.351, 5.426, 5.463, 5.545, 5.831, 6.012, 6.089, 6.149, 6.290, 6.433, 6.744, 6.866, and 7.064 MeV. Angular distributions of strongly excited states were compared with distorted-wave Born-approximation calculations. The ground state and a state at 5.351 MeV have angular distributions characteristic of l = 0 neutron pickup whereas states at 0.273, 1.615, 4.551, 6.012, and 6.744 MeV correspond to l = 1 neutron pickup, and states at 0.238, 1.54, and 4.036 MeV correspond to l = 2 neutron pickup. The following new spin and parity assignments are made: 1.51, $(1/2^-)$; 1.54, $(3/2)^+$; 1.615, $(3/2)^-$; 4.036, $3/2^+$, $(5/2^+)$; 4.551, $1/2^-$, $3/2^-$; 5.351, $1/2^+$; 6.012, $3/2^-$, $(1/2^-)$; 6.744, $3/2^-$, $(1/2^-)$; energies in MeV. Relative spectroscopic factors were extracted and compared with predicted configurations of negative-parity states in mass-19 nuclei and with the predicted ground-state neutron configuration of ^{20}Ne. Analog states in the mirror nucleus, ^{19}F, are discussed. (auth)

52456 PRODUCTION CROSS SECTION OF ISOTOPES EMITTED IN 70-MeV α-PARTICLE INTERACTIONS ON C AND N TARGETS. Baixeras-Aiguabella, C.; Jung, M.; Jacquot, C.; Girardin, L.; Schmitt, R. (Centre de Recherches Nucleaires, Strasbourg). Phys. Rev., C; 2: 1194-9(Oct 1970).

The experimental cross sections for production of the Li, Be, and B isotopes and their isotopic ratios were determined for interactions produced by 70-MeV α particles with the carbon and nitrogen nuclei of a nuclear emulsion. The cross-section values as well as the isotopic ratios were fitted with the help of Rudstam's formula; there is good agreement for the carbon target and poor agreement for the nitrogen target. (auth)

52457 RELATIVE STRENGTHS OF CENTRAL, SPIN-ORBIT, AND TENSOR PARTS OF THE SUSSEX INTERACTION. Kakkar, I.; Waghmare, Y. R. (Indian Inst. of Tech., Kanpur). Phys. Rev., C; 2: 1191-4(Oct 1970).

The effects of central, spin-orbit, and tensor components of the Sussex interaction on various ground-state properties of ^{16}O and ^{12}C nuclei were studied. It was observed that a major contribution to the binding energy comes from the central part of the interaction alone. In the case of ^{16}O, almost all of the $1p_{\frac{3}{2}}-1p_{\frac{1}{2}}$ splitting comes from the spin-orbit component. However, in ^{12}C, the tensor part of the interaction also provides large splitting, but its contribution is of the wrong sign. (auth)

52458 NUCLEAR LIFETIME OF THE ^{19}Ne 275-keV LEVEL. Bharuth-Ram, K. (Nuclear Physics Lab., Oxford); Gill, R. D.; Jackson, K. P.; Povh, B.; Warburton, E. K. Phys. Rev., C; 2: 1210-13(Oct 1970).

The mean life of the 275-keV second-excited state of ^{19}Ne was measured to be 61.4 ± 3.0 psec. The $^3He(^{16}Ne,\alpha)^{19}Ne$ reaction and the gas-target recoil-distance technique were used. The 275-keV

state decays by E1 emission to the ground state. The strength of this E1 transition is equal within errors to that of the mirror transition in ^{19}F. This result is discussed. (auth)

52459 NUCLEAR POLARIZATION IN THE $^{11}B(d,p)^{12}B$ REACTION. III. Williams, R. L. Jr.; Pfeiffer, Loren; Wells, J. C. Jr.; Madansky, L. (Johns Hopkins Univ., Baltimore). Phys. Rev., C; 2: 1219-24(Oct 1970).

New measurements of the nuclear spin-lattice relaxation times of ^{12}B implanted in Au, Pd, and Pt established lower limits of 60, 185, and 270 sec °K, respectively, of T_1T for ^{12}B in these metals. In conjunction with prior measurements of the effective moment of ^{12}B in these metals, these T_1T values show that the Knight shift of ^{12}B in Au is positive, while in Pd and Pt it is negative. By using a common enhancement factor in these metals, the ^{12}B magnetic dipole moment was found to be $\mu = (+1.002\ 85^{+0.000\ 11}_{-0.000\ 15})\mu_N$. The ^{12}B electric quadrupole moment was measured for the first time using the asymmetry of the ^{12}B resonance lines in Be foil under magnetic-field reversal and the estimated field gradient at ^9Be lattice positions. The result is $Q(^{12}B) = (+0.030 \pm 0.008) \times 10^{-24}$ cm^2. (auth)

52460 $^{14}N(\alpha,d)^{16}O$ REACTION AT 40 MeV. Zisman, M. S.; McClatchie, E. A.; Harvey, B. G. (Univ. of California, Berkeley). Phys. Rev., C; 2: 1271-8(Oct 1970).

The $^{14}N(\alpha,d)^{16}O$ reaction was investigated up to an excitation energy of 20 MeV using a 40-MeV α beam from the Berkeley 88-in. cyclotron. Angular distributions were obtained for the three strongest levels at 14.40 ± 0.03, 14.82 ± 0.03, and 16.24 ± 0.04 MeV. Widths for these states, with the experimental resolution subtracted in quadrature, are 30 ± 30, 69 ± 30, and 125 ± 50 keV, respectively. Evidence for the probable $[^{14}N(1^+) + (d_{\frac{5}{2}})^2_{0^+}]$ configuration of the three states is discussed. (auth)

52461 ELEMENTARY-PARTICLE TREATMENT OF MUON CAPTURE AND RADIATIVE PION CAPTURE IN ^6Li. Delorme, J. (Institut de Physique Nucleaire de Lyon, Villeurbanne, France). Nucl. Phys.; B19: 573-88(1970).

The elementary-particle approach to muon capture and radiative pion capture in nuclei is here discussed for the particular case of the transition between the ground states of ^6Li and ^6He. Its validity is proved by comparison with standard calculations in the impulse approximation. The calculated capture rates are found to be consistent with the experimental data in contradistinction to previous estimates. (auth)

52462 NUCLEAR GAMMA RAYS IN ^{19}F FOLLOWING STOPPING PIONS. Blomquist, R.; Eckhause, M.; Kane, F. R.; Kane, J. R.; Martin, P.; Miller, G. H.; Sapp, W. W.; Spence, C. B.; Welsh, R. E. (Coll. of William and Mary, Williamsburg, Va.). Nucl. Phys.; B19: 632-6(1970).

The yield per stopped pion of 197 and 109 keV γ-rays in CF_2 has been found to depend on target thickness. The probable excitation mechanism and methods to reduce such yields in studies of muonic and pionic atoms are discussed. More precise determinations of the energies of the first and second excited states of ^{19}F are listed. (auth)

52463 GROUND STATE PHOTONEUTRON ANGULAR DISTRIBUTIONS IN THE GIANT RESONANCE OF ^{16}O. Jury, J. W.; Hewitt, J. S.; McNeill, K. G. (Univ. of Toronto). Can. J. Phys.; 48: 1635-48(15 Jul 1970).

Photoneutron spectra for transitions to the ground state in the giant resonance of ^{16}O were measured with high neutron energy resolution ($\Delta E \sim 60$ keV) at angles of 50, 66, 82, 98, 114, 130, and 146 degrees relative to the direction of the incident bremsstrahlung beam. The spectra at the various angles were measured during successive experimental runs using a single 50 m time-of-flight spectrometer. The different angles were obtained by bending the electron beam relative to the direction of the flight path. Angular normalization was achieved by using a fast neutron monitor located at the end of a short flight path which was always normal to the reaction plane. Legendre coefficients for the angular distributions were extracted as functions of the excitation energy. From the energy dependence of the coefficients, interference effects are evident in the ground state (γ,n) cross section in the region from 17 to 30 MeV. (auth) (Canada)

52464 TWO-NUCLEON-TRANSFER REACTIONS INDUCED BY POLARIZED PROTONS. Hardy, J. C.; Bacher, A. D.; Plattner, G. R.; Macdonald, J. A.; Sextro, R. G. (Univ. of California, Berkeley). Phys. Rev. Lett.; 25: 298-302(3 Aug 1970).

The (p,t) and (p,^{3}He) reactions on ^{16}O and ^{15}N targets were studied using 43.8-MeV polarized protons. The observed cross sections and asymmetries for most states are well reproduced by distorted-wave Born-approximation calculations. However, of the five L = 2 (S = 0) transitions observed, two exhibit asymmetries which disagree markedly with the other three and with distorted-wave Born-approximation predictions. Thus asymmetries in two-nucleon-transfer reactions do not always appear to be simply characteristic of the transferred quantum numbers. (auth)

52465 μ-CAPTURE MECHANISM IN LIGHT COMPLEX NUCLEI. Pratt, T. A. E. C. (Illinois State Univ., Normal). Nuovo Cim., 68A: 477-96(1 Aug 1970).

The μ-capture process resulting in the emission of a single neutron is treated as a double two-body process in the giant-dipole-resonance model: $\mu^- + (A,Z) = (A,Z-1) + \nu$, $(A,Z-1) = (A-1,Z-1) + n$. The kinematics of the process is studied taking into account the recoil of the (A,Z−1) nucleus. It is found that there exist situations where there is an instantaneous zero-degree angular separation between the neutron and the (A−1,Z−1) nucleus at the time of decay of the (A,Z−1) nucleus. It is conjectured that this might destroy some delicate information about the μ-capture mechanism like asymmetry and polarization, which otherwise might have been carried by the neutrons. In addition to the widths of the fine structure of the neutron asymmetry spectrum and the neutron asymmetry, the Doppler broadening of the (A−1,Z−1) levels, in particular the 6.322-MeV level of ^{15}N, is discussed. The predictions of the direct model are systematically compared with those of the giant dipole resonance and with the experimental results. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 89

Refer also to abstracts 50347, 50558, 51835, 52404, 52407, 52421, 52428, 52430, 52436, 52438, 52439, 52442, 52446, 52447, 52453, 52455, 52465, 52538, 52546, 52563, 52566, 52623, 52650, 52704, 52710, 52717, 52732, and 52739.

52466 (CEA-N-1290) TABLES OF FISSION-PRODUCT GAMMA TRANSITIONS. Blachot, Jean; Barre, Bertrand (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Jun 1970. 32p. (In French). Dep. CFSTI (U. S. Sales Only).

The first table includes isotopes from ^{81}Se to ^{151}Pm with half lives greater than one minute, arranged in order of increasing mass number. The ten main gamma rays and their relative and absolute energies are given. The second table is a classification of gamma rays in order of increasing photon energy. 63 references. (auth) (France)

52467 (COO-498-82) TECHNICAL PROGRESS REPORT, DECEMBER 1, 1969-NOVEMBER 30, 1970. Mihelich, John W. (Notre Dame Univ., Ind.). Contract AT(11-1)-498. 8p. Dep. CFSTI.

Progress is briefly summarized for an experimental program to obtain high-resolution spectra of radioisotopes using reactor or accelerator produced sources and Coulomb excitation by an ^{16}O beam. The program involves single and coincidence spectra, directional correlation measurements, determination of nuclear level half-lives, and Coulomb excitation. (H.D.R.)

52468 (CTC-43) REACTION MECHANISM STUDIES OF SINGLE AND DOUBLE DIFFERENTIAL CROSS SECTIONS FROM THE REACTION $^{24}Mg(\alpha;\alpha',\gamma)^{24}Mg$. McNeilly, Gregory Scott (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). 7 Sep 1970. Contract W-7405-eng-26. 135p. Dep. CFSTI.

Thesis. Submitted to Florida State Univ., Tallahassee.

Alpha-gamma angular correlations (double differential cross sections-DDCS) from the reaction $^{24}Mg(\alpha;\alpha',\gamma)^{24}Mg$ were measured at an incident alpha particle energy of 16.65 MeV. An 800-keV thick target provided energy averaged results. The scattered alpha particles were detected (in the horizontal plane) at 7.5 degree steps from 27.5° to 140° in the laboratory frame of reference. The gamma detector (also in the horizontal plane) was moved through 15 detector positions, thus measuring 15 points defining an alpha-gamma angular correlation for each particle angle, from which DDCS parameters were extracted. DDCS parameters were obtained from the reaction $^{24}Mg(\alpha;\alpha_{1.37},\gamma_{1.37})^{24}Mg$ and from the reaction $^{24}Mg(\alpha;\alpha_{4.12} + \alpha_{4.23},\gamma_{1.37})^{24}Mg$. The DDCS data are expressed in millibarns per square steradian (mb/sr^2). The DDCS data, together with available single differential cross section (SDCS) data from the ground state, the 1.37 MeV state, and the 4.12 MeV state of ^{24}Mg, were analyzed. Theoretical fits to these data were calculated using a DWBA plus

Hauser–Feshbach (HF) method, and a coupled-channels (CC) plus HF method. The inelastic levels in ^{24}Mg were treated as rotational excitations of a deformed nucleus. The HF contribution to the cross sections is significant for elastic scattering, and dominates the calculated inelastic SDCS. However, the calculated HF contribution is near zero in the angular region 60° – 120° for the anisotropic DDCS parameters. DWBA plus HF fits are in close agreement with CC plus HF fits for the SDCS data, and show slightly less agreement for the DDCS data. (auth)

52469 (EURFNR–809) HIGH RESOLUTION MEASUREMENTS OF RADIATIVE NEUTRON CAPTURE IN ^{47}Ti, ^{56}Fe, ^{58}Ni, ^{60}Ni, AND ^{61}Ni BETWEEN 7 AND 200 keV. Ernst, A.; Frohner, F. H.; Kompe, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Jun 1970. 21p. (KFK–1231; CN–26/11; CONF-700605-7). Dep. CFSTI (U. S. Sales Only).

From 2nd International Conference on Nuclear Data for Reactors, Helsinki, Finland.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

Neutron capture in enriched samples of ^{47}Ti, ^{56}Fe, ^{58}Ni, ^{60}Ni, and ^{61}Ni, has been measured in the energy range 7 to 200 keV with the time-of-flight method. The time resolution was better than 2 ns/m. Neutrons were produced by a pulsed 3-MV Van de Graaff accelerator via the ^{7}Li(p,n) reaction. Capture events were detected with an 800-liter liquid scintillator tank. The ^{197}Au(n,γ) cross section served as standard. Incorporation of transmission results, especially of resonance spins and total widths, in the analysis and careful treatment of multiple scattering permitted the determination of radiation widths for a large number of s-wave resonances. (auth)

52470 (KFK–1069) METHOD FOR NEUTRON RESONANCE SPIN ASSIGNMENT BY DIFFERENTIAL SCATTERING ANALYSIS. Kirouac, George J.; Nebe, Juergen (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Sep 1969. 29p. Dep. CFSTI (U. S. Sales Only).

An exploratory investigation of the use of few-angle neutron scattering measurements to assign resonance spins and parities is presented. The cross section shape as a function of the scattering angle is illustrated for s-, p-, and d-wave neutrons. Textbook examples are calculated for isolated resonances and for interfering resonances. A specific example is given for ^{40}Ca; and a scattering experiment, which is in preparation, is outlined. It is concluded that study of the resonance shape observed at a few scattering angles can be used profitably to assign spins and parities even for closely spaced interfering resonances. (auth)

52471 (NP–18361) A STUDY OF THE REACTION ^{27}Al (p,α)^{24}Mg AND A SEARCH FOR A 5.5 MeV LEVEL IN ^{7}Li. Harvey, Peter John (Melbourne Univ., Parkville (Australia). School of Physics). Mar 1969. 109p. Dep. CFSTI (U. S. Sales Only).

Thesis.

Measurements were made of the energy, strength and width of 42 resonances in the reactions ^{27}Al(p,α_0)^{24}Mg and ^{27}Al(p,α_1)^{24}Mg for incident proton energies between 1.5 and 2.64 MeV. The measurements were made primarily to provide for astrophysical calculations of reactions which occur during the silicon burning stage of the more massive stars. A thin-target excitation function was obtained for both alpha particle groups for incident proton energies from 1.64 to 2.64 MeV. Each peak in this curve was fitted with the convolution of a Lorentzian with the energy distribution of protons in the target in order to extract the resonance parameters. Angular distributions were measured using a semi-thick target for suitable resonances. Analysis of these angular distributions, by matching with calculated distributions, limited the possible J^{π} values of these resonances. A correlation is included of the ^{27}Al(p,α) resonance parameters with the ^{27}Al(p,γ) resonance data obtained by other workers. A theoretical prediction of a level near 5.5 MeV excitation energy in ^{7}Li, based on a rotational model calculation, prompted a search for this level by inelastic scattering of 14-MeV neutrons. The experimental evidence for the existence of such a level is inconclusive, some of it coming from previous inelastic neutron scattering studies. Considerably greater counting statistics were obtained under equivalent or superior experimental conditions to those of previous ^{7}Li(n,n′) studies but no evidence for a level near 5.5 MeV was obtained. (auth) (Australia)

52472 (NP–18444) COMPOUND NUCLEUS PROCESS IN REACTION MECHANISM AND NUCLEAR STRUCTURE STUDIES. Hellstroem, Jan O. V. (Australian National Univ., Canberra). Feb 1970. 240p. Dep. CFSTI (U. S. Sales Only).

Thesis.

The theory of Wolfenstein, Hauser and Feshbach, and Satchler for the compound nucleus process was used in combination with the optical model and the distorted-wave Born approximation for reaction mechanism studies. The mean level widths at high excitation energies in the compound nuclei ^{24}Mg and ^{32}S were investigated using Fourier methods in addition to the method of Ericson and Brink and Stephen. Evidence for intermediate structure is found in two of the reactions considered. The compound nucleus process was employed to investigate spins of levels in the nuclei ^{62}Cu and ^{64}Cu. Gamma-ray angular distributions following (p,n) reactions were compared with theoretical predictions for different spin sequences. The spin of the 426-keV level in ^{62}Cu was measured as 3^{+}. Unique spin assignments were obtained for the 159-keV (2^{+}), 278-keV (2^{+}) and 609-keV (2^{+}) levels in ^{64}Cu, and the most probable spins for the other levels were found to be 344-keV (1^{+}), 362-keV (1^{+}), 739-keV (2^{+} or 3^{+}), 746-keV (3^{+}), 878-keV (1^{+} or 2^{+}), 895-keV (3^{+}) and 927-keV (1^{+}). Multipole mixing ratios of the γ rays observed were also obtained. (Australia)

52473 (NP–18455) PHOTONEUTRON EXPERIMENTS ON 2s-1d SHELL NUCLEI: ^{24}Mg, ^{28}Si, ^{32}S, AND ^{39}K. Webb, David Vernon (Melbourne Univ., Parkville (Australia). School of Physics). Nov 1969. 293p. Dep. CFSTI (U. S. Sales Only).

Thesis.

Photoneutron cross sections of the 4 nuclei were measured with bremsstrahlung, between the particular threshold and 30 MeV, using an activation technique suited to the short half-lives of the residual nuclei, which decay by positron emission. The 3 even-even, self-conjugate nuclei were studied with high resolution, stepping the end-point energy in 50-keV steps. In each case fine structure 200 to 400 keV wide was resolved over the giant resonance, and intermediate structure 1 to 2 MeV wide existed to 30 MeV. An attempt to explain the apparent similarity of the 3 cross sections, by comparison with various theoretical attempts to produce structure in the giant resonance, suggested that there is an underlying mechanism that can be understood in terms of low-energy collective excitations of the core, coupled to the dominant dipole states. The ^{39}K photoneutron cross section to the isomeric first excited state of ^{38}K in 200-keV steps was resolved to 10 peaks up to 29 MeV, each about 1 MeV wide. The structure was compared to the predictions of the shell model calculation. Results for zero- and finite-range residual interactions both described the low energy side of the giant resonance conclusively, but gave little reinforcement at higher energies. (Australia)

52474 (ORNL–4475) GAMMA-RAY SPECTRA ARISING FROM FAST-NEUTRON INTERACTIONS IN ELEMENTS FOUND IN SOILS, CONCRETES, AND STRUCTURAL MATERIALS. Maerker, R. E.; Muckenthaler, F. J. (Oak Ridge National Lab., Tenn.). Apr 1970. Contract W-7405-eng-26. 238p. Dep. CFSTI.

Experimental data are presented for the production of secondary gamma rays arising from the interaction of a fission-like spectrum of fast neutrons with oxygen, carbon, iron, aluminum, copper, zinc, titanium, nickel, silicon, calcium, potassium, sodium, barium, sulfur, and a stainless steel. Measurements of the gamma-ray spectra for these elements were made at the Tower Shielding Facility with a carefully calibrated 5-in. by 5-in. NaI(Tl) detector. These data are useful in evaluating the accuracy of (n,xγ) cross-section sets. The data are differential in the gamma-ray energy from 1 MeV to approximately 6.5 MeV and are expressed as values of 4π times the average differential gamma-ray production cross section at 90 deg to the incident neutron beam for all neutrons in the beam lying above 1 MeV. These results are estimated to have an accuracy of ±30% and include the contribution from both discrete and continuum gamma rays. Comparisons of these data with results obtained by averaging previously published differential cross sections over the incident spectrum indicate that considerable differences exist between the values obtained at the Tower Shielding Facility and the earlier data. Very approximate experimental data are presented for gamma rays arising from resonance capture of neutrons from a 1/E energy spectrum in the energy range 10 to 200 keV. (auth)

52475 (ORNL–4516) Al NEUTRON ELASTIC- AND INELASTIC-SCATTERING CROSS SECTIONS FROM 4.19 TO 8.56 MeV. Kinney, W. E.; Perey, F. G. (Oak Ridge National Lab., Tenn.). Oct 1970. Contract W-7405-eng-26. 72p. Dep. NTIS.

Numerical values of Al neutron elastic- and inelastic-scattering cross sections in the incident neutron energy range of 4.19 to 8.56 MeV are presented. The data are compared with the results of others and found to be consistent with them. The ENDF/B Al elastic angular distributions are in good agreement with experiments at angles less than 60° but are in poor agreement at angles larger

than this. The ENDF/B Al inelastic excitation functions could be improved and extended through the use of data which has become available since the evaluation. (auth)

52476 (ORNL-TM-2891) EVALUATION OF THE CROSS SECTIONS OF IRON: ENDF/B MAT 1101. Irving, D. C.; Straker, E. A. (Oak Ridge National Lab., Tenn.). 10 Sep 1970. 17p. Dep. CFSTI.

The neutron cross sections for iron have been evaluated and placed in the ENDF/B format with the material (MAT) number 1101. The total cross section was evaluated from recent experimental measurements and is compatible with measurements from very thick sample penetration made at the Tower Shielding Facility. Other data were taken from evaluations by J. J. Schmidt as contained in the UKAEA Nuclear Data File, DFN 64. (auth)

52477 (ORO-3235-55) NUCLEAR AND COSMOCHEMISTRY. Annual Progress Report. Kuroda, P. K. (Arkansas Univ., Fayetteville. Dept. of Chemistry). 31 Jul 1970. Contract AT-(40-1)-3235. 21p. Dep. CFSTI.

Research progress in nuclear and cosmochemistry at the University of Arkansas Dept. of Chemistry from August 1, 1969 to July 31, 1970 is reported. (J.W.R.)

52478 (RPI-328-199) keV NEUTRON CAPTURE AND TRANSMISSION MEASUREMENTS ON ^{50}Cr, ^{52}Cr, ^{53}Cr, ^{54}Cr, ^{60}Ni, AND V. Stieglitz, R. G.; Hockenbury, R. W.; Block, R. C. (Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Science). 1970. Contract AT(30-1)-328. 76p. Dep. CFSTI.

Neutron capture and transmission measurements were performed on vanadium and enriched samples of ^{58}Ni, ^{50}Cr, ^{52}Cr, ^{53}Cr, ^{54}Cr with an experimental resolution of 0.6 nanoseconds per meter. The capture measurements cover the energy range 0.1 to 200 keV, while the transmission measurements extend to over 300 keV. Parameters are extracted for both s-wave and p-wave resonances. S-wave and p-wave strength functions, potential scattering radii, average capture cross sections and resonance absorption integrals are determined. The radiation width is found to vary widely among the s-wave resonances of each nuclide. (auth)

52479 (TID-22361(Pt.3)) A COMPILATION OF BETA EXCITED X-RAY SPECTRA. PART III. (^{14}C, ^{3}H, ^{35}S, ^{89}Sr, ^{99}Tc, ^{149}W, ^{85}Kr). Preuss, Luther E.; Artman, C.; Bugenis, C. (Edsel B. Ford Inst. for Medical Research, Detroit, Mich.). Jun 1970. Contract AT(11-1)-1593. 391p. Dep. CFSTI.

52480 (UCRL-50902) THRESHOLD PHOTONEUTRON CROSS SECTIONS FOR MEDIUM AND HEAVY NUCLEI. Baglan, Robert J. (California Univ., Livermore. Lawrence Radiation Lab.). 25 Aug 1970. 144p. Dep. CFSTI.

Thesis. Submitted to Univ. of California, Berkeley.

The following (γ,n) cross sections were measured with very high resolution in the energy range from threshold to ~1 MeV above threshold: ^{25}Mg, ^{52,53}Cr, ^{56,57}Fe, and ^{206,207,208}Pb. Many individual compound-nucleus resonances were resolved and area-analyzed to give $\Gamma_{\gamma 0}$, from which E1-strength functions, $\langle\Gamma_{\gamma 0}/D\rangle$, were obtained. In addition, the cross sections were investigated for the occurrence of three distinct nuclear phenomenon: 1) nonresonant neutron capture; 2) doorway states; and 3) analog states. Nonresonant neutron-capture cross sections of 0.5 mb/sr for ^{207}Pb and 4.2 μb/sr for ^{56}Fe were determined by measuring the asymmetry of resonances. In ^{207}Pb, additional evidence, in the form of an envelope of γ-ray widths, was found for the previously reported $\frac{1}{2}^+$ doorway state at 500 keV. A correlation analysis for the γ-ray and neutron widths of the fine structure of the doorway state determined its ground-state γ-ray width to be 36.5 eV. Evidence was found for a $\frac{1}{2}^+$ doorway state near 225 keV in ^{207}Pb. The analogs of the ground and first excited states of ^{25}Na were seen in ^{25}Mg, and the following lower limits were determined for their Γ_n's: 0.25 and 1.8 eV, respectively. Five analog states of ^{56}Mn may have been excited in ^{56}Fe, and lower limits for their $\Gamma_{\gamma 0}$'s were determined. (auth)

52481 HARTREE-FOCK ORBITALS WITH S-STATE INTERACTIONS. Kulkarni, D. R.; Pandya, S. P. (Physical Research Lab., Ahmedabad, India). Lett. Nuovo Cim.; 4: 133-6(25 Jul 1970).

Hartree-Fock orbitals in the s-d shell with s-state interactions are studied by calculating the single-particle orbitals, the Hartree-Fock gap, and the projected spectra for the ground rotational band of ^{20}Ne. Calculations are shown for the appropriate radial integrals separately and taken together, and the latter are compared with previous results. (R.W.R.)

52482 MEASUREMENT OF THE RADIATION WIDTH OF THE 2.85 keV NEUTRON RESONANCE AND OF THE THERMAL NEUTRON CAPTURE CROSS SECTION IN SODIUM. Yamamuro, N. (Rensselaer Polytechnic Inst., Troy, N. Y.); Hockenbury, R. W.; Block, R. C.; Wolfe, R. H. Contract AT(30-1)-328. Nucl. Sci. Eng.; 41: 445-9(Sep 1970).

The radiation width Γ_γ of the 2.85-keV neutron resonance and the thermal capture cross section of sodium were measured. Photoneutrons were produced by bombarding a Ta target with electrons, and detected using a ^{10}B-NaI neutron detector. Gamma rays were detected with a liquid scintillator with a discriminator set to accept photon energies of 3 to 15 MeV. Four targets were used to determine the radiation width of the 2.85-keV resonance: the results yielded a weighted average of $\Gamma_\gamma = (0.47 \pm 0.015)$ eV. The capture cross section from 0.025 to 0.200 eV was fitted by the least-squares method to the equation $\sigma_\gamma = 0.50\ (0.0253/E)^{0.50}$. The 0.0253-eV cross section was determined as 0.50 ± 0.03 b; and the exponent was 0.50 ± 0.01, in agreement with a 1/v cross-section dependence. If one assumes that the thermal capture cross section results from the 2.85-keV resonance, then the 0.50 b thermal cross section corresponds to a radiation width of 0.32 eV for the resonance. The source of this disagreement, and that among results from different laboratories, is unknown. (R.W.R.)

52483 STUDY OF THE EXCITED STATES IN ^{30}Si BY MEANS OF THE ^{30}Si($\alpha,\alpha'\gamma$)^{30}Si REACTION. Ohnuma, H.; Kuchnir, F. T.; Gemmell, D. S.; Holland, R. E.; Meyer-Schuetzmeister, L.; Puttaswamy, N. G. (Argonne National Lab., Ill.). Nucl. Phys.; A149: 141-60(1970).

The method II of Litherland and Ferguson was applied to study states in ^{30}Si by the ^{30}Si($\alpha,\alpha'\gamma$)^{30}Si reaction. An annular Si detector placed at 180° to the incident beam and 25 and 30 cm^3 Ge(Li) detectors were used for particle and gamma-ray detection, respectively. The results for the first two excited states agree well with previous measurements. The spin assignments 1^+ and 0^+ are suggested for the 3.767 and 3.786 MeV levels, respectively. The 4.808 MeV state has spin and parity 2^+, the 4.826 MeV state is most likely 2^+ and the 5.948 MeV state is 4^+. Gamma-ray decay schemes for many states were obtained. No spin 3^- state was strongly excited in the present reaction, and no strong transitions from the 3^- states to the ground state were observed. (auth)

52484 γ-SPECTRUM OF ^{74}Se ACCOMPANYING THE β-DECAY OF ^{74}Br. Goering, S.; Hartrott, M. v. (Karlsruhe Nuclear Research Centre, Ger.). Nucl. Phys.; A152: 241-50(1970).

The spectrum of ^{74}Se following the β-decay of ^{74}Br has been analyzed with a Ge(Li) γ-spectrometer and a high resolution Ge(Li)$\gamma\gamma$ coincidence spectrometer. A partial decay scheme is proposed containing 15 excited states placed at 634.61, 1269.13, 1362.9, 1884.1, 2108.0, 2563.6, 2918.7, 3077.5, 3675.2, 4442.4, 4496.6, 4517.5, 4592.0, 4662.0 and 4700 keV. The ^{74}Br sources are produced by the Se(d, xn)^{74}Br process and subsequent mass separation. (auth)

52485 A CRITICAL STUDY OF THE INTERNAL BREMSSTRAHLUNG SPECTRUM FROM ^{32}P. Berenyi, D.; Varga, D. (Inst. of Nuclear Research, Debrecen, Hungary). Nucl. Phys.; A138: 685-96(1969).

An experimental study of the IB spectrum from ^{32}P was carried out for the clarification of the contradictions among the various experimental investigations. This study was based on a critical analysis of the measuring conditions and the evaluation process. The "classical" absorption as well as the magnetic deflection method for the elimination of the distortion effect of the electrons coming from the source (i.e., the external bremsstrahlung) were used in the same experiment. Special care was taken to eliminate the sources of possible systematic errors. As a result of this study, the observed maximum deviation of the experimental distribution from the KUB-Nilsson theory was about 6% in the energy region from 60 to 1060 keV. Other recent experiments lead to deviations from this theory amounting to 30-40% and 80-100%. The probable reasons of these deviations are also discussed. (auth)

52486 RATIO OF ELECTRON CAPTURE TO POSITION EMISSION IN THE DECAY OF ^{58}Co. Williams, A. (National Physical Lab., Teddington, Eng.). Nucl. Phys.; A153: 665-72 (1970).

The electron capture to positron emission ratio for the decay of ^{58}Co to the 810-keV level of ^{58}Fe has been measured as $\epsilon/\beta^+ = 5.76$, with a standard error of ±0.03 and a systematic error of ±0.03. Calculations of the value of this ratio using electron wave functions obtained from relativistic Hartree-Fock calculations made at Los Alamos, and including radiative corrections give $(\epsilon/\beta^+)_{calc} = 5.46$, with a standard error of ±0.2 and systematic error of ±0.1. The large error is due to the uncertainity in the value of the position transition energy. Similar calculations for ^{22}Na give $(\epsilon/\beta^+)_{calc} = 0.1099$ with a standard error of ±0.0067 and

a systematic error of ±0.002, which is in good agreement with previous theoretical values. (auth)

52487 STUDY OF ^{33}S LEVELS WITH THE ^{34}S(τ,α)^{33}S REACTION. Leighton, H. G.; Wolff, A. C. (State Univ., Utrecht). Nucl. Phys.; A151: 71-80(1970).

The differential cross sections of 13 α-particle groups from the ^{34}S(τ, α)^{33}S reaction were measured at E_τ = 12 MeV with a 90 cm split-pole magnetic spectrograph to determine the distribution of hole strengths in ^{33}S. To aid in the DWBA analysis of the angular distributions the differential cross section for elastic scattering of 18 MeV α-particles on ^{34}S was measured. Good agreement was found between the experimental spectroscopic factors and the result of recent shell-model calculations. The levels at 2.31, 2.87, 3.94 and 6.36 MeV were found to have l = 2. An l-value of 2 was also found for the 3.83 MeV level contrary to the tentative l = 3 assignment reported from a study of the ^{32}S(d, p)^{33}S reaction. The j-dependence in (τ,α) reactions observed for l = 2 distributions at 18 MeV was not evident in the present study. (auth)

52488 PRODUCTION OF THE Δ(1236) ISOBAR IN COMPLEX NUCLEI; DOUBLE DIFFERENTIAL CROSS SECTIONS FOR THE RECOIL NUCLEI FROM THE ^{65}Cu(p, pπ$^+$)^{65}Ni REACTION. Remsberg, L. P. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev.; 188: 1698-1702(20 Dec 1969).

Angular distributions of the recoil nuclei from the ^{65}Cu(p, pπ$^+$)^{65}Ni reaction were measured at incident-proton energies of 1.0 and 2.8 GeV. Kinetic-energy spectra of the recoil nuclei were obtained for angles of 15° and 45° at 1.0 GeV. These energy spectra are directly related to the effective mass of all the outgoing particles, and prominent peaks corresponding to production of the Δ(1236) isobar were observed. The experimental data were compared with the results of calculations based on the model of Ericson, Selleri, and Van de Walle, and reasonably good agreement was obtained. (auth)

52489 EXCITATION FUNCTIONS FOR ^{3}He INDUCED NUCLEAR REACTIONS IN Cu. Golchert, Norbert W. (Argonne National Lab., Ill.); Sedlet, Jacob; Gardner, Donald G. Nucl. Phys.; A152: 419-33(1970).

Excitation functions for 21 nuclear reactions induced by ^{3}He ions on Cu were measured up to 35 MeV for all radioactive products of half-life greater than 10 min, and the long-lived products were surveyed to 70 MeV. The stacked foil technique was used and the induced radioactivities chemically separated from each foil. The excitation function data are presented, compared to other similar ^{3}He and α-particle data, and an attempt is made to deduce reaction mechanism. The results indicate that in the 25 to 35 MeV region, the (^{3}He, xn) reaction accounts for only 10% of the total cross section while the (^{3}He, p2n) reaction accounts for 65% of the total. Particularly at higher incident ^{3}He energies, a sequential direct interaction-compound nucleus mechanism appears to adequately describe the present results. (auth)

52490 INELASTIC ELECTRON SCATTERING FROM ^{56}Fe. Peterson, R. J. (Yale Univ., New Haven); Theissen, Horst; Alston, W. J. Contract AT(30-1)-2726. Nucl. Phys.; A153: 610-24(1970).

The inelastic scattering of 60.2-MeV electrons from ^{56}Fe is investigated, and angular distributions are measured for seven 2^+ states and one 3^- state. The results are compared to DWBA predictions to extract values of the electromagnetic reduced transition rates and the transition radii. (auth)

52491 STUDY OF ^{53}Mn FOLLOWING THE REACTION (α,pγ). Szoeghy, I. M.; Cujec, B.; Dayras, R. (Univ. Laval, Quebec). Nucl. Phys.; A153: 529-52(1970). (In French).

The ^{53}Mn levels are investigated up to 2.4 MeV excitation following the ^{50}Cr(α,pγ)^{53}Mn reaction. The (αp,γ) angular correlations are measured in the Litherland–Ferguson geometry II. The measured excitation function between 8 and 11 MeV permitted to choose for each level a suitable incident energy. For the levels at 1.438, 1.617, 2.271 and 2.404 MeV the following J^π values are proposed: $11/2^-$, $9/2^-$, $5/2$ and $3/2^-$. Gamma-ray branching and mixing ratios were also obtained. In ^{53}Mn, the M1 transitions are inhibited so that they are in the shell-model equivalent nucleus ^{51}V. Also the level ordering is the same for both nuclei. The results are compared with previous experiments and theoretical predictions. (auth)

52492 INVESTIGATION OF SEVERAL NUCLEAR REACTIONS INDUCED IN NaI BY 12.6 TO 18.2 MeV NEUTRONS. Aldefeld, B. (Univ., Hamburg). Nucl. Phys.; A145: 569-80 (1970). (In German).

Neutron reactions with proton and α-particle emission induced in ^{23}Na have been studied for neutron energies between 12.65 and 18.25 MeV. A NaI crystal served as both target and detector. Pulse-shape discrimination was used to distinguish protons, α-particles and γ-rays. Spectra of all protons and α-particles were measured. These were produced in (n, pγ + n, pn + n, np) and (n, αγ + n, αn + n, nα) reactions. In addition, proton and α-particle spectra were studied in coincidence with secondary neutrons which were detected in a scintillator. These spectra consist of charged particles produced in (n, np + n, pn) and (n, nα + n, αn) reactions. The results were analyzed on the basis of the statistical theory. The spectra can be regarded as evaporation spectra. No evidence for a direct interaction contribution was found. (auth)

52493 MEASUREMENT OF NUCLEAR REACTION TIMES BY THE USE OF THE BLOCKING EFFECT. Maruyama, M. (Japan Atomic Energy Research Inst., Tokai); Tsukada, K.; Ozawa, K.; Fujimoto, F.; Komaki, K.; Mannami, M.; Sakurai, T. Nucl. Phys.; A145: 581-92(1970).

A new method is presented to measure nuclear reaction times and lifetimes of excited nuclear states from 1 as to 10 fs, based on the blocking effect of charged particles in single crystals. Reaction time measurements are described for the ^{28}Si(p,p')^{28}Si (1.78 MeV, 2^+), ^{70}Ge(p,p')^{70}Ge (1.04 MeV, 2^+) and ^{72}Ge(p,p')^{72}Ge (0.835 MeV, 2^+) reactions at E = 3.61 to 5.91 MeV. Planar blocking patterns by the (111) crystal plane of thin single crystals were observed for protons scattered at 90° leaving residual nuclei in definite states. Clear reduction of the blocking effect from that of the elastic scattering was found for the ^{70}Ge(p,p')^{70}Ge* and ^{72}Ge(p,p')^{72}Ge* reactions and not for the ^{28}Si(p,p')^{28}Si* reaction. Reaction times τ derived from the reduction were 36 ± 23 and 42 ± 19 as for the ^{70}Ge(p,p')^{70}Ge* and ^{72}Ge(p,p')^{72}Ge* reactions at E = 4.84 MeV and $\tau \leq 6$ as for the ^{28}Si(p,p')^{28}Si* reaction at E = 3.61–5.86 MeV. (auth)

52494 FINE STRUCTURE IN NUCLEAR CHARGE DISTRIBUTION. Heisenberg, J. (Stanford Univ., Calif.); Hofstadter, R.; McCarthy, J. S.; Sick, I.; Clark, B. C.; Herman, R.; Ravenhall, D. G. pp 33-9 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Very precise measurements of electron scattering by ^{40}Ca were made at electron energies of 249.3 and 496.8 MeV in order to gain information on the nuclear charge distribution. The data were analyzed using a charge distribution with a small oscillatory term. The method of analysis was checked for model and energy dependence. A similar analysis was performed for electron scattering by ^{208}Pb at 248 and 502 MeV. (J.W.R.)

52495 EFFECTS OF LONG RANGE CORRELATIONS ON ELASTIC ELECTRON SCATTERING. Vinciguerra, D.; Blum, D.; Stovall, T. (Ecole Normale Superieure, Orsay, France. Laboratoire de l'Accelerateur Lineaire, Orsay, France). pp 83-5 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

It is shown that experimental deviations from the shell model calculations of the elastic electron scattering cross sections at high momentum transfer are caused by long-range as well as short-range correlations. The particular long-range correlations examined are those manifested by interorbital mixing in the particle-hole model. Calculations are performed for electron elastic scattering by ^{40}Ca using the particle-hole model with harmonic oscillator basis states. The results are compared with experiment. (J.W.R.)

52496 NEUTRON SPECTRA AND ASYMMETRIES IN MUON CAPTURE. Sundelin, Ronald M.; Edelstein, Richard M. (Carnegie-Mellon Univ., Pittsburgh). pp 150-6 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The asymmetry in the angular distribution of neutrons emitted following muon capture in Si and Ca was measured. The measurements were made by precessing stopped muons in a vertical magnetic field, and observing recoils from the neutrons in a liquid scintillation counter. Moderate positive asymmetries were found. This result is in agreement with some other recent experimental data and theoretical calculations. (J.W.R.)

52497 NUCLEAR γ-RAYS FOLLOWING μ-CAPTURE. Backenstoss, G. (CERN, Geneva); Charalambus, S.; Daniel, H.; Lynen, U.; Malsburg, Ch. v. d.; Poelz, G.; Povel, H.; Schmitt, H.; Springer, K.; Tauscher, L. pp 160-2 of High-Energy Physics and Nuclear

Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The yields of nuclear γ-rays following muon capture in Co and Mn were measured using telescope techniques in conjunction with Ge detectors. The γ-rays were assigned to transitions in Cr and Fe isotopes. (J.W.R.)

52498 INTERPRETATION OF NEUTRON ASYMMETRY IN POLARIZED MUON CAPTURE. Fujii, A. (Institut de Physique Nucleaire, Orsay, France. Sophia Univ., Tokyo); Leonardi, R.; Rosa-Clot, M. pp 171-3 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

An attempt is made to explain the inversion in the sign of the neutron asymmetry parameters for polarized muon capture by ^{40}Ca in the neutron energy range 20 to 30 MeV. It is shown that the peak strength of the Gamow–Teller transition exceeds the strength of the Fermi interaction. (J.W.R.)

52499 EXPERIMENTAL DETERMINATION OF THE PROBABILITY OF THE PROCESS (μ^-,ν) ON ^{27}Al, ^{28}Si, ^{51}V NUCLEI. Bunatyan, G.; Evseev, V.; Nikityuk, L.; Pokrovskii, V.; Ribakov, V.; Yutlandov, I. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 182-4 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The relative probabilities of the (μ^-,ν) process on ^{27}Al, ^{28}Si, ^{51}V, and ^{56}Fe were determined by the activation method. The results are compared with theoretical calculations. (J.W.R.)

52500 RECENT EXPERIMENTAL WORK ON PIONIC X-RAYS. Backenstoss, G. (CERN, Geneva. Univ., Karlsruhe, Ger.). pp 469-87 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The current status of experimental research on π-mesic atoms is surveyed. The experimental techniques are discussed, and some of the data are reviewed. The need for more accurate and detailed measurements is emphasized. (J.W.R.)

52501 RECENT WORK ON PARITY MIXING IN NUCLEAR STATES. Lobashov, V. M. (Ioffe Inst. of Physics and Tech., Leningrad). pp 713-21 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Two experiments on parity mixing in nuclear states are described. The experiments involve the measurement of the circular polarization of the γ quanta from the 1290-keV M2 transition in ^{41}K following ^{41}A decay and from the n + p → D + γ reaction. The experimental procedures are described, and the results are presented. (J.W.R.)

52502 (d,n) REACTIONS ON EVEN ARGON ISOTOPES. Hagen, M. (Hahn-Meitner Institut fuer Kernforschung, Berlin); Janetzki, U.; Maier, K.-H.; Fuchs, H. Nucl. Phys.; A152: 404-18(1970).

Neutrons from the 5.6-MeV deuteron bombardment of ^{36,38,40}Ar have been investigated by the time-of-flight method. Altogether 23 angular distributions of (d,n) transitions to states in ^{37,39,41}K were obtained and have been analyzed with DWBA to yield l-values and spectroscopic factors. By comparison with ^{40}Ar(d,p) data, levels at 8.38 and 8.87 MeV in ^{41}K are proposed as the two lowest analogue states. Similarly, a level at 7.72 MeV in ^{39}K is shown to contain the major fraction of the lowest $\frac{1}{2}^-$ analogue state. The experimental transition strengths are compared to predictions of the simple shell model, and deviations are discussed. The extended shell-model calculations of Glaudemans et al. and Wildenthal et al. yield qualitatively correct predictions for transitions to the lowest even-parity states in ^{37}K and ^{39}K. (auth)

52503 (p,d) REACTION IN THE TITANIUM ISOTOPES. Plauger, P. J.; Kashy, E. (Michigan State Univ., East Lansing). Nucl. Phys.; A152: 609-30(1970).

Angular distributions for the ^{49}Ti(p,d)^{48}Ti reaction were obtained for E_p = 25 to 45 MeV to study the energy dependence of various methods of extracting spectroscopic factors. In the DWBA analysis for the principal l_n = 1, 2 and 3 transitions, it was found that correcting for finite-range and non-locality in the interaction eliminated the energy dependence observed in spectroscopic factors obtained with local zero-range calculations. On the basis of these results, spectroscopic factors were measured for ^{46,48,50}Ti(p,d)^{45,47,49}Ti reactions and compared to the sum-rule predictions of French and Macfarlane. Most of the disagreement observed is attributed to incorrect treatment of Q-dependence in the calculations. (auth)

52504 PROTON POLARIZATION IN THE ^{40}Ca(d,p_0)^{41}Ca REACTION AT 5.58 AND 6.50 MeV. Kuenhold, K. A.; Donoghue, T. R. (Ohio State Univ., Columbus). Nucl. Phys.; A152: 395-400(1970).

Angular distributions of the polarization of the protons from the ^{40}Ca(d,p_0)^{41}Ca reaction have been measured at 5.58 and 6.50 MeV for seven emission angles between 20° and 135° (lab). A conventional double scattering technique was used, where the polarization was analyzed by scattering from a helium target at 45° (lab). The polarization is generally negative over the entire angular range reaching an extremum of −0.26 ± 0.08 at 6.50 MeV and 110°. DWBA calculations were not successful in describing the data. (auth)

52505 EFFECT OF DYNAMICAL DEFORMATION IN ELASTIC ELECTRON SCATTERING ON THE CHARGE DISTRIBUTIONS OF THE CALCIUM ISOTOPES. Raphael, Robert B. (Naval Research Lab., Washington, D. C. Catholic Univ. of America, Washington, D. C.); Rosen, Mervine. Phys. Rev., C; 2: 1040-7 (Sep 1970).

The presence of dynamical deformations in the ground-state charge distributions of calcium isotopes provides a basis for understanding two well-known but very different effects observed in elastic electron scattering from these isotopes. The first, seen at low momentum transfer, is the anomalous isotope dependence of the nuclear charge radius. It is shown that there is a deformation-dependent contribution to the rms radius, whose magnitude can be obtained from inelastic electron and α scattering via a sum rule and which leads to a prediction of the isotopic dependence in substantial agreement with experiment. The second observed effect, visible at high momentum transfer, is the appearance of oscillations in the ^{40}Ca and ^{48}Ca charge distributions, as revealed by fits to the elastic electron scattering data at 750 MeV. It is shown that an additional contribution of dynamical deformations to monopole elastic electron scattering, observable only at high momentum transfer, may be interpreted as due to an effective spherically symmetric "modulating charge" distribution superimposed on the smoothly varying distribution obtained at lower energies. This modulating charge is calculated explicitly and exhibits an oscillatory behavior. (auth)

52506 MIGDAL'S QUASIPARTICLE MODEL AND RADIATIVE MUON CAPTURE IN ^{40}Ca. Borchi, E.; De Gennaro, S. (Univ., Florence). Phys. Rev., C; 2: 1012-19(Sep 1970).

The radiative photon spectrum and the branching ratio R of radiative-to-ordinary muon capture rate in ^{40}Ca was evaluated, taking into account the nucleon–nucleon residual interaction by means of Migdal's quasiparticle model. The most important effect of the residual interaction was to reduce both the ordinary and radiative rate about 40% lower than that obtained in the closure-harmonic-oscillator model. This result differs from that obtained by Fearing using the giant-dipole-resonance model, while it confirms the prediction of Rood and Tolhoek (RT) that the branching ratio R would be nearly independent of the nuclear model. The circular polarization of the photons, P_γ, was also evaluated. Values of P_γ were greater than the RT values by about 15% in the high-energy range. In the low-energy range, values of P_γ were in close agreement with those of RT. For the maximum energy of the photon spectrum, the average value k_{max} = 90.5 MeV, which is very close to the RT value, was obtained. Comparing results with the experimental data of Conversi, Diebold, and Di Lella, the calculation requires $g_p = (12.4 \pm 2.8)g_A$ to fit the experimental values, where g_p is the induced pseudoscalar coupling constant and g_A the axial-vector coupling constant. (auth)

52507 ^{28,30}Si(n,xγ) REACTIONS FOR 5.3 ≤ E_n ≤ 9.0 MeV. Dickens, J. K. (Oak Ridge National Lab., Tenn.). Phys. Rev., C; 2: 990-1005(Sep 1970).

Interactions of neutrons with silicon were studied by measuring γ production cross sections. For incident mean neutron energies E_n = 5.35, 5.85, 6.4, 6.9, 7.45, 7.95, 8.5, and 9.0 MeV, spectra were obtained for a natural silicon sample. The γ rays were detected using a coaxial Ge(Li) detector of 30-cm^3 active volume. Data were obtained for γ scattering angles of 55 and 90° for all E_n, of 35° for E_n = 7.45 and 8.5 MeV, and 75° for E_n = 6.4 and 7.45 MeV. Time of flight was used with the detector to discriminate against pulses due to neutrons and background radiation. Data were also obtained at E_n = 5.9 MeV, θ_γ = 55° for a sample of $^{28}SiO_2$ enriched to 95% in

^{28}Si, and for a similarly enriched sample of $^{30}SiO_2$. These data were studied to obtain absolute cross sections for production of γ rays for the incident neutron energies quoted above. The cross sections were compared, where possible, with previously measured values; agreement was fair. The spectra were studied for γ rays that could be associated with deexcitation of nuclear levels having unknown decay modes. For ^{28}Si, γ rays were found having energies appropriate for decay of levels at excitation energies E_x = 4.736, 4.836, 4.893, and 5.249 MeV. For ^{30}Si, γ rays were found for decay of levels at excitation energies $E_x \geq 4.826$ MeV. The spin of the 4.826-MeV state in ^{30}Si is reasonably limited to 2, 3, or 4. No previously unknown transitions were found for ^{28}Si or ^{26}Mg; for ^{26}Al, the evidence suggests that the 1.624-MeV level is a doublet of 3-keV separation. (auth)

52508 PROTON TRANSFER REACTIONS ON ^{26}Mg AND ^{30}Si VIA THE REACTIONS ^{26}Mg(^{3}He,d)^{27}Al AND ^{30}Si(^{3}He,d)^{31}P. Lutz, H. F.; Heikkinen, D. W.; Bartolini, W.; Curtis, T. H. (Univ. of California, Livermore). Phys. Rev., C; 2: 981-9(Sep 1970).

The proton transfer reactions on ^{26}Mg and ^{30}Si were studied using the reactions ^{26}Mg(^{3}He,d)^{27}Al and ^{30}Si(^{3}He,d)^{31}P at 17.85 MeV. Transitions to T> and T< levels were obtained. The spectroscopic factors from distorted-wave Born-approximation analysis were compared with information obtained at lower bombarding energies. The number of T< states is discussed qualitatively in terms of fragmentation caused by core-polarization states. The value for the isovector potential responsible for the splitting of the T> and T< states was determined for several orbits. Charge radii calculated for Coulomb energy differences indicated that ^{27}Al requires a larger radius parameter than ^{31}P. (auth)

52509 ANGULAR-CORRELATION STUDY OF ^{23}Na USING THE ^{24}Mg(t,$\alpha\gamma$)^{23}Na REACTION. Poletti, A. R.; Becker, J. A.; McDonald, R. E. (Lockheed Palo Alto Research Lab., Palo Alto, Calif.). Phys. Rev., C; 2: 964-74(Sep 1970).

The ^{24}Mg(t,$\alpha\gamma$)^{23}Na reaction was used to investigate the spins and decay modes of many of the levels in ^{23}Na below an excitation energy of 6 MeV, as well as the multipole mixing ratios of the radiative transitions between these levels. Gamma radiation was detected in NaI(Tl) detectors located at angles between 0 and 90°, while outgoing α particles were detected in an annular detector placed at 180° with respect to the beam direction. Two-parameter techniques were used to measure the $\alpha-\gamma$ coincidence spectra. Analysis of the resultant γ angular correlations, when combined with already existing data, enabled the following unambiguous spin assignments to be made: 2.98-MeV level $J = 3/2$, 3.68-MeV level $J = 5/2$, 3.91-MeV level $J = 1/2$. Limitations on the possible spins of the 4.78-, 5.38-, and 5.74-MeV levels were obtained. The results are discussed in terms of the Nilsson model for ^{23}Na. (auth)

52510 PRODUCTION OF ^{32}P AND ^{33}P FROM VARIOUS TARGETS WITH 550-MeV PROTONS. Korteling, Ralph (Simon Fraser Univ., Burnaby, British Columbia); Kiefer, Richard. Phys. Rev., C; 2: 957-63(Sep 1970).

Cross sections for the production of ^{32}P and ^{33}P were determined with 550-MeV protons on 19 target elements ranging from titanium to uranium. The main features of the results are an exponential decrease of the cross sections with increasing target mass up to zinc, a broad maximum between zirconium and tin, and an increase in cross section with increasing target mass between tantalum and uranium. All of the features were correlated with similar results of ^{22}Na and ^{24}Na. In addition, an analytic function was used to represent the experimental results in the region where ^{32}P and ^{33}P are produced primarily as spallation products. (auth)

52511 ALPHA-PARTICLE SCATTERING FROM THE 3^+ UNNATURAL AND THE 4^+ NATURAL PARITY STATES IN ^{24}Mg. Drentje, A. G.; Roeders, J. D. A. (Univ. of Groningen, Netherlands). Phys. Lett.; 32B: 356-8(3 Aug 1970).

Excitation of the 3^+ (5.22 MeV) level of ^{24}Mg by α-particle scattering at 20 MeV is shown to proceed entirely via compound nucleus formation, contrary to earlier statements. Compound nucleus processes dominate also the excitation of the 4^+ (6.00 MeV) level. (auth)

52512 SPECTRA OF HIGH-ENERGY PHOTONS EMITTED FROM THE COMPOUND SYSTEM ^{64}Zn IN VARIOUS NUCLEAR REACTIONS. Drake, D. (Los Alamos Scientific Lab., N. Mex.); Whetstone, S. L.; Halpern, I. Phys. Lett.; 32B: 349-50 (3 Aug 1970).

Strong evidence for fast capture of protons is deduced from measurements of the high-energy γ-ray spectra in bombardments by protons, ^{3}He, and ^{4}He particles that produce the compound system ^{64}Zn at an excitation energy of about 30 MeV. (auth)

52513 SHELL-MODEL STRUCTURE OF ^{35}Cl–^{35}Ar. Wildenthal, B. H. (Michigan State Univ., East Lansing. Oak Ridge National Lab., Tenn.); Halbert, E. C.; McGrory, J. B.; Kuo, T. T. S. Phys. Lett.; 32B: 339-42(3 Aug 1970).

Energy levels, E2 and M1 observables, and spectroscopic factors are calculated for ^{35}Cl–^{35}Ar and compared with experimental data. The theoretical results are obtained by computations in a full $(0s)^4(0p)^{12}(1s,0d)^{A-16}$ shell-model vector space. Two alternative "realistic" interactions are used. (auth)

52514 M5 AND HIGHER MAGNETIC MOMENTS IN ELASTIC ELECTRON SCATTERING. Li, G. C.; Sick, I.; Walecka, J. D.; Walker, G. E. Contract F44620-68-C-0075. Phys. Lett.; 32B: 317-20(3 Aug 1970).

The feasibility of determining the higher nuclear ground state magnetic moments through elastic electron scattering is considered. Theoretical and experimental results are presented for the M5 moment of ^{27}Al and the M9 moment ^{209}Bi. (auth)

52515 ^{30}Si(α,nγ)^{33}S ANGULAR-CORRELATION MEASUREMENTS. Cummings, J. E.; Donahue, D. J. (Univ. of Arizona, Tucson). Phys. Rev., C; 2: 942-8(Sep 1970).

The particle–γ angular-correlation method of Litherland and Ferguson was used to gain information on the multipole mixing ratios for the 1.97 → 0.0-MeV, 2.31 → 0.84-MeV, and 2.31 → 0.0-MeV transitions in ^{33}S. Ions of $^4He^{2+}$ with E = 7.52 MeV populated the excited states through the reaction ^{30}Si(α,n)^{33}S*. Neutrons were detected in the direction of the beam axis. Pulse-shape discrimination for determining neutron–γ coincidence was studied. Gamma rays were detected by 3-in. × 3-in. NaI(Tl) crystals at angles of 45, 55, 65, and 90° with respect to the beam axis. Results were examined with regard to predictions of the strong-coupling rotational model. (auth)

52516 COMPARISON OF THE PROTON POLARIZATION AND γ-RAY CIRCULAR POLARIZATION IN THE ^{40}Ca(d,p_1)^{41}Ca$^{1.95}$ REACTION. Roy, G.; Sherif, H.; Moss, G. A.; Saunders, W. M. (Univ. of Alberta, Edmonton). Nucl. Phys.; A147: 586-92(1970).

We have measured the proton polarization in the ^{40}Ca(d,p_1)^{41}Ca$^{1.95}$ reaction at a deuteron energy of 4.8 MeV. The results are compared with the circular polarization measurements of the γ-ray from the decay of the 1.95 MeV state of ^{41}Ca, produced in the same reaction at the same deuteron energy by Freiberg et al. A simple relationship between the proton and γ-ray circular polarizations ($P_\gamma = -3.23\ P_{proton}$) calculated with no spin-orbit distortions in the deuteron and proton channels is not verified by experiment. The disagreement, however, is small. DWBA calculations including spin-orbit distortions agree quite well with the proton polarization. We conclude that spin-orbit distortions are necessary in DWBA calculations, but their effect is not a major one. (auth)

52517 NEUTRONS EMITTED AFTER HEAVY-ION BOMBARDMENT: EFFECTS OF TRANSFER REACTIONS ON PARTICLE SPECTRA. Simon, William G.; Ahrens, Stuart T. (Univ. of Wyoming, Laramie). Phys. Rev., C; 2: 1292-1304 (Oct 1970).

Measurements of neutron spectra from the reactions ^{16}O(Ni,xn) and ^{16}O(Ag,xn) with 160-MeV ^{16}O ions and natural targets were made. Neutrons were detected at 15° intervals from 15 to 165°. Detection was accomplished with nuclear emulsions, using the internal-radiator method. The most striking feature of the spectra is the pronounced backward peaking in the c.m. system with ratios of $\sigma(180°)/\sigma(0°)$ as high as 2.0. This peaking may be caused by transfer reactions. Following the transfer reaction, a part of the incoming ion travels forward with its initial velocity, while the remaining partially fused system is traveling backward in the c.m. system. Evaporated particles from the partially fused system are thus backward peaked in the c.m. system. The charged-particle spectra for these same reactions, as measured by other investigators, are also analyzed in terms of transfer reactions. Qualitative agreement with some unusual aspects of the measured spectra is obtained. (auth)

52518 INELASTIC SCATTERING OF POLARIZED PROTONS AT 30.3 MeV BY ^{54,56}Fe, ^{58}Ni, ^{120}Sn, AND ^{208}Pb. Karban, O. (Birmingham Univ., Eng.); Greaves, P. D.; Hnizdo, V.; Lowe, J.; Greenlees, G. W. Nucl. Phys.; A147: 461-80(1970).

Experimental differential cross sections and asymmetries were measured for proton inelastic scattering at 30.3 MeV from strongly excited 2^+ states in ^{54,56}Fe, ^{58}Ni, and ^{120}Sn and 3^- states in ^{58}Ni, ^{120}Sn, and ^{208}Pb. A coupled-channels analysis was performed using both the collective and shell-model descriptions of the nuclei. A good fit was obtained to all the data with the vibrational model when the whole optical potential was deformed; the deformation parameters deduced here are in agreement with those reported

elsewhere. A microscopic description of the interaction using effective nucleon–nucleon forces was less successful and some aspects of the problem are discussed. (auth)

52519 LOW-ENERGY γ-RAY SPECTRA OF ^{75}Se AND ^{124}Sb. Pratt, William W. (Pennsylvania State Univ., University Park). Nucl. Phys.; A147: 601-5(1970).

The low-energy γ-ray spectra of ^{75}Se and ^{124}Sb have been measured using a thin-crystal scintillation spectrometer in conjunction with an absorption technique to reduce the effect of degraded high-energy γ-rays. A 24.4 keV γ-ray was found in ^{75}Se with an intensity of 0.032 ± 0.010 relative to I_γ (265 keV) = 100. An upper limit of 0.001 photons per disintegration has been found for the intensity of a 7.7 keV γ-ray in ^{124}Sb for which tentative evidence has previously been reported. (auth)

52520 ASSESSMENT OF TWO-STEP PROCESSES IN (p,t) REACTIONS. Ascuitto, R. J.; Glendenning, Norman K. (Univ. of California, Berkeley. Yale Univ., New Haven). Phys. Rev., C; 2: 1260-70(Oct 1970).

Multiple-step processes (core excitation) were evaluated for the (p,t) reaction at a typical energy (30 MeV) and for a typical moderately collective spherical nucleus (nickel). The model nucleus has three kinds of states; the ground and collective 2^+, which have a strong direct transition, other typical noncollective states, which also can be produced in a single step, and a two-phonon triplet, which can be produced only through multiple-step processes. These latter are produced as strongly as the other noncollective states and the angular distributions and polarizations are characterized by the multipolarity of the over-all transition and not by the multiplicity of the reaction mechanism. Comparison is made with the distorted-wave Born approximation. It was found to underestimate the (p,t) cross sections to all three types of states, and that even relative cross sections are in error by up to a factor 2, and absolute cross sections by as much as a factor 5. (auth)

52521 ANALOGUE STATES OF ^{86}Sr AND THE ^{87}Sr(p,p)^{87}Sr REACTION. Slater, D. C.; Cosman, E. R.; Spencer, J. E. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Nucl. Phys.; A147: 650-6(1970).

The isobaric-analogue states of levels in ^{86}Sr have been studied by elastic proton scattering from ^{87}Sr for bombarding energies E_p = 4.5 to 7.5 MeV. Several resonances were observed whose spacings and strengths match well to neutron particle-hole states known from the ^{87}Sr(d,p)^{88}Sr reaction. Simple Breit–Wigner curves have been compared with the data. The energetic and spectroscopic information so obtained has been compared with that from the ^{87}Sr(d,p)^{88}Sr reaction. No inelastic transitions in the range 0 to 3 MeV excitation in ^{87}Sr were detected from on- and off-resonance magnetic spectrograph exposures also taken here. (auth)

52522 BETA DECAY OF ^{47}K, ^{50}Ca, AND ^{50}Sc. Warburton, E. K.; Alburger, D. E.; Engelbertink, G. A. P. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., C; 2: 1427-33(Oct 1970).

The isotopes ^{47}K, ^{50}Ca, and ^{50}Sc were formed by the bombardment of ^{48}Ca with 3.3-MeV tritons. Half-lives of 18.1 ± 1.0, 13.9 ± 0.6, and 102.5 ± 0.5 sec, respectively, were measured by following the decay of the γ rays emitted by these nuclides. The γ rays were observed with a Ge(Li) detector, and γ energies and relative intensities were obtained. ^{47}K decays to the second and third excited states of ^{47}Ca; ^{50}Ca to the fourth excited state of ^{50}Sc; and ^{50}Sc to the second and third excited states of ^{50}Ti. The results for ^{47}K, together with previous results, establish the spin-parity of the 2578- and 2599-keV levels of ^{47}Ca as $\frac{3}{2}^+$ and $\frac{1}{2}^+$, respectively. The results for ^{50}Sc and ^{50}Ca are consistent with previous work, but are more accurate. (auth)

52523 LEVELS IN ^{33}P OF E_{ex} < 4.3 MeV. Harris, W. R.; Nagatani, K.; Olness, J. W. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., C; 2: 1412-26(Oct 1970).

Bound states of ^{33}P below 4.3-MeV excitation energy were investigated via the ^{31}P(t,p_γ)^{33}P reaction at triton bombarding energies of 2.45 and 3.10 MeV. Proton and γ singles measurements, together with p–γ coincidence measurements, determined the principal γ decay modes for the eight states previously reported below 4.3-MeV excitation energy in ^{33}P. Evidence was also obtained for the γ decay of a previously unreported state at 4.19 MeV. Angular-correlation measurements, in conjunction with lifetime restrictions obtained from Ge(Li) studies on the γ Doppler shifts led to the following determinations of spin parity for these levels [MeV(J^π)] in ^{33}P: 0.0($\frac{1}{2}^+$), 1.43($\frac{1}{2}^+$), 1.85($\frac{5}{2}^+$), 2.54($\frac{5}{2}^+$), 3.28($\frac{5}{2}$,$\frac{5}{2}$), 3.49($\frac{5}{2}$ or $\frac{1}{2}$), 3.63($\frac{1}{2}^+$), 4.05($\frac{3}{2}$,$\frac{5}{2}$), 4.19($\frac{5}{2}$,$\frac{7}{2}$), and 4.22($\frac{5}{2}^-$). These results serve in part to confirm the previously published assignments for the ground state and first three excited states, and establish new information for the higher-lying states. Restrictions on multipole mixing in the deexcitation transitions are summarized and compared with previous results. Finally, the experimental spectrum of ^{33}P levels thus obtained is compared with applicable shell-model calculations for these low-lying levels. (auth)

52524 ELASTIC SCATTERING OF 39.6-MeV PROTONS BY EVEN ISOTOPES OF Ni AND Zn. Liers, H. S.; Boyd, R. N.; Poppe, C. H.; Sievers, J. A.; Watson, D. L. (Univ. of Minnesota, Minneapolis). Phys. Rev., C; 2: 1399-1411(Oct 1970).

Differential cross sections and polarizations for 39.6-MeV protons elastically scattered from the isotopes ^{58,60,62,64}Ni and ^{64,66,68}Zn were measured using the University of Minnesota linear accelerator. An atomic-beam-type polarized source was used for the polarization measurements. The data were analyzed using both the standard optical model and a recent approach to the optical model developed by Greenlees, Pyle, and Tang, in which the real part of the central potential and the spin-orbit potential were obtained from the two-nucleon potential and the neutron, proton, and matter point-density distributions. Root-mean-square radii of the real central potentials were extracted from the data, but no systematic trend was evident for an isotopic sequence. (auth)

52525 STUDY OF ENERGY LEVELS OF ^{29}Si. Dehnhard, D. (Univ. of Minnesota, Minneapolis); Yntema, J. L. Phys. Rev., C; 2: 1390-9(Oct 1970).

The ^{30}Si(^{3}He,α)^{29}Si reaction was studied by use of the 12-MeV ^{3}He beam of the Argonne EN Tandem Van de Graaff and a broad-range magnetic spectrograph. Energy levels of ^{29}Si up to about 10-MeV excitation were observed, and spectra at 10 angles were taken. Relative spectroscopic factors were extracted with the aid of distorted-wave calculations. The results were compared with previous neutron-pickup reactions on ^{30}Si and with theoretical predictions calculated within the framework of the rotational model. (auth)

52526 ^{86}Sr(d,p)^{87}Sr REACTION IN THE REGION OF THE ^{88}Sr(d,n)^{88}Y^A THRESHOLD. Zaidi, S. A. A.; Coker, W. R.; Martin, D. G. (Univ. of Texas, Austin). Phys. Rev., C; 2: 1384-9(Oct 1970).

^{86}Sr(d,p)^{87}Sr excitation curves were measured at 90, 140, 160, and 170° for four states in ^{87}Sr: the $d_{\frac{5}{2}}$ ground state, 1.03-MeV $s_{\frac{1}{2}}$ state, 2.00-MeV d doublet, and 2.45-MeV $d_{\frac{3}{2}}$ state at deuteron energies from 5.0 to 10.5 MeV. The excitation curves for ground state and 1.03-MeV $s_{\frac{1}{2}}$ state display cusps at the threshold of the charge-exchange-coupled channel, ^{88}Sr(d,n)^{88}Y^A. The data are fit with coupled-channel Born-approximation calculations. (auth)

52527 EXCITATION FUNCTIONS FOR THE REACTIONS ^{34}S(p,n)^{34}Cl AND ^{31}P(alpha,n)^{34}Cl. Umbarger, C. J.; Kemper, K. W.; Nelson, J. W.; Plendl, H. S. (Florida State Univ., Tallahassee). Phys. Rev., C; 2: 1378-84(Oct 1970).

Excitation curves for ^{34}S(p,n)^{34}Cl and ^{31}P(α,n)^{34}Cl were measured from the observed thresholds at 6438 ± 10 and 6360 ± 10 keV, respectively, to 1.6 MeV above threshold by detecting the residual radioactivity. Two prominent resonant structures were found in both reactions at the same excitation energies, 12.9 and 13.9 MeV, in the compound nucleus ^{35}Cl. Excitation curves for ^{31}P(α,α_0) were also measured in the region of these resonances, but no similar prominent resonances were found. Arguments are presented that indicate a T = $\frac{3}{2}$ assignment for these resonances. Absolute values of the total cross section were determined for the above (p,n) and (α,n) reactions and also for ^{34}S(p,n)^{34}Cl^m and ^{31}P(α,n)^{34}Cl^m. (auth)

52528 PHOTONUCLEAR REACTIONS IN IRON AND ALUMINUM BOMBARDED WITH HIGH-ENERGY ELECTRONS. Fulmer, C. B. (Oak Ridge National Lab., Tenn.); Toth, K. S.; Williams, I. R.; Handley, T. H.; Dell, G. F.; Callis, E. L.; Jenkins, T. M.; Wyckoff, J. M. Phys. Rev., C; 2: 1371-8 (Oct 1970).

Previously reported evidence for photofission of iron was investigated by a more extensive study. Thin foils of iron were bombarded with beams of 1.5-, 3-, 5-, and 16-GeV electrons. Gamma spectroscopy and radiochemical measurements were used to measure yields of radionuclides produced in the targets. The yields of 25 nuclides were measured for the bombarded iron foils; these include eight nuclides in the mass region 22 ≤ A ≤ 35. A thin aluminum target was bombarded with 16-GeV electrons, and the yields of seven radionuclides were measured. The yield of ^{24}Na in a thick iron target was measured as a function of target thickness and compared with that of radionuclides produced by cascade-evaporation reactions. The experimental evidence obtained in this series of experiments indicates that nuclides of mass <35 produced in the iron targets are the result of a fission-like process. For cascade-evaporation reaction products, there is a decrease in the variation of yield with ΔZ as the bremsstrahlung energy is increased. (auth)

52529 RADIATIVE DECAY OF $d_{\frac{3}{2}}$-HOLE STATES. Holland, R. E.; Lynch, F. J. (Argonne National Lab., Ill.). Phys. Rev., C; 2: 1365-70(Oct 1970).

Lifetimes were measured for ^{39}K, ^{41}Ca, and ^{43}Ca states formed by promoting a particle from the $d_{\frac{3}{2}}$ shell to the $f_{\frac{7}{2}}$ shell. In ^{43}Ca, this state occurs at 990-keV excitation and has a mean life of 0.12 ± 0.04 nsec. By taking account of the branching ratio it was found that the partial mean life for the transition $\frac{3}{2}^+ \rightarrow \frac{7}{2}^-$ is 45 ± 16 nsec, which represents an inhibition of 120 relative to the single-particle estimate. In ^{41}Ca, the hole state occurs at 2010 keV and has a lifetime of 0.8 ± 0.2 nsec. No other branch is observed, so this is the mean life for the $\frac{3}{2}^+ \rightarrow \frac{7}{2}^-$ transition. It is inhibited by a factor 62 relative to the single-particle estimate. In ^{39}K the state occurs at 2820 keV and the mean life for this $\frac{7}{2}^- \rightarrow \frac{3}{2}^+$ transition is less than 0.08 nsec; the inhibition here is less than 18. All of the above rates are consistent with the theoretical model of Kurath and Lawson. From additional data on ^{43}Ca, it was found that the partial mean life for the 612-keV $\frac{3}{2}^+ \rightarrow \frac{7}{2}^-$ transition is 1.4 nsec. This is 0.06 times the single-particle value and is not explainable in the scheme of Kurath and Lawson. (auth)

52530 ISOSPIN NONCONSERVATION IN THE ^{28}Si(d,α_1)^{26}Al$_{g.s.,T=1}$ REACTION. Richter, A. (Argonne National Lab., Ill.); Meyer-Schuetzmeister, L.; Stoltzfus, J. C.; von Ehrenstein, D. Phys. Rev., C; 2: 1361-4(Oct 1970).

The isospin-nonconserving reaction ^{28}(d,α_1)^{26}Al(0.23, T = 1) was investigated at deuteron energies between 12 and 17 MeV. This experiment was prompted by Noble's recent proposal that the direct-nuclear part of the cross section in the isospin-violating (d,α) reaction may proceed via an isospin-mixed 2^+ doublet in ^{6}Li. No evidence was found for this mechanism; but even at the high bombarding energies, the largest fraction of the isospin-forbidden cross section is due to compound-nucleus processes. This was determined from the strong fluctuations in the excitation functions. (auth)

52531 PROPERTIES OF ^{37}Cl LEVELS AND THE SYSTEM OF $\frac{7}{2}^-$ ANALOG AND ANTIANALOG LEVELS IN A = 35 AND 37 NUCLEI. Harris, Gale I.; Perrizo, J. J. (Aerospace Research Labs., Wright-Patterson Air Force Base, Ohio). Phys. Rev., C; 2: 1347-60(Oct 1970).

The γ-decay properties of J^π, T = $\frac{7}{2}^-$, $\frac{5}{2}$ analog of the ground state of ^{37}S, observed previously at E_p = 1887 keV in the ^{36}S(p,γ)^{37}Cl reaction, were reexamined. Transitions to previously unobserved levels in ^{37}Cl at E_x = 4.811 and 5.574 MeV were found in addition to the known strong M1 transition to the J^π, T = $\frac{7}{2}^-$, $\frac{3}{2}$ antianalog state at E_x = 3.105 MeV. Other weak transitions suggest the presence of levels at E_x = 3.911 and 6.482 MeV. The data are consistent with a hypothesis that the 4.811- and 5.574-MeV levels, and possibly the other two suggested levels, are members of the group of $\frac{7}{2}^-$, T = $\frac{3}{2}$ configuration states expected from fragmentation of the antianalog state by spin and isospin recoupling of the $d_{\frac{3}{2}}^3$ nucleon group in A = 37. Detailed analysis of the strengths of the analog M1 and Gamow–Teller β decays to the 3.105-MeV level, and of the M1-E2 and M2-E3 mixing ratios, yields information on the wave function of the antianalog state and a prediction of the mean life of this level. A similar analysis of the $\frac{7}{2}^-$ parent, analog, and antianalog system in A = 35 is performed and the results are presented. In both the A = 35 and 37 systems, recoupling in the $d_{\frac{3}{2}}^n$ nucleon group appears necessary to explain the data. Additional information on ^{37}Cl levels obtained from measurements at the analog resonance, and at the E_p = 1147-keV resonance, include the more accurate value Q = 8384.5 ± 1.5 keV for the ^{36}S(p,γ)^{37}Cl reaction, the energies 1.723 ± 0.002 and 3.1048 ± 0.0005 MeV for the first and third excited states, and the mean life $\tau_m = 0.17^{+0.09}_{-0.05}$ and ≥1.0 psec for the 1.723- and 3.105-MeV levels, respectively. The results of angular-correlation measurements at the 1147-keV resonance are consistent with earlier assignments of J = $\frac{7}{2}$ for the 1.723-MeV level. The results are compared with recent shell-model calculations involving $d_{\frac{3}{2}}^4 f_{\frac{7}{2}}$ and $d_{\frac{3}{2}}^3 p_{\frac{3}{2}}$ configurations. The observed M2 transition rates are successfully explained using bare-nucleon g factors when recoupling of the $d_{\frac{3}{2}}^3$ group is considered. (auth)

52532 8543-keV 6^+ STATE IN ^{28}Si AND THE GROUND-STATE ROTATIONAL BAND. Huang, F. C. P.; McDaniels, D. K. (Univ. of Oregon, Eugene). Phys. Rev., C; 2: 1342-6(Oct 1970).

Evidence for the existence of a ground-state rotational band in the nucleus ^{28}Si was rounded out by a lifetime measurement of the 8543-keV 6^+ level. Using the 2203-keV resonance in the ^{27}Al(p,γ)^{28}Si reaction, and the Doppler-shift attenuation technique, 18 ± 6 fsec was found for the mean life of the 6^+ state. It follows that the strength of the $6^+ \rightarrow 4^+$ 3926-keV transition is 9.4 ± 3.0 Weisskopf units (W.u.), in good agreement with theoretical predictions. This measurement removes objections that arose from an earlier result of 2.9 W.u. for the $6^+ \rightarrow 4^+$ transition strength. (auth)

52533 INELASTIC SCATTERING OF 40-MeV PROTONS BY ^{58}Ni AND ^{60}Ni AND ANALYSIS IN COUPLED CHANNELS. Lingappa, N.; Greenlees, G. W. (Univ. of Minnesota, Minneapolis). Phys. Rev., C; 2: 1329-41(Oct 1970).

Data from the inelastic scattering of 40-MeV protons by ^{58}Ni and ^{60}Ni are presented and analyzed in terms of a coupled-channel approach. Previous discrepancies between the experimental and theoretical distributions of the first excited 2^+ states are removed. The nature of coupled-channel calculations at this energy is discussed, with reference to absorptive strengths and form factors. 4^+ states around 2.5-MeV excitation are shown to require one-phonon mixing in order to explain the observed cross sections. Spin-parity assignments are given for states at 3.2-, 5.1-, and 6.1-MeV excitation in ^{60}Ni. (auth)

52534 NEW LOW-LYING STATES IN ^{57}Ni OBSERVED IN THE ^{58}Ni(^{3}He,α)^{57}Ni REACTION. Zurmuehle, R. W.; Balamuth, D. P.; Holden, James E. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., C; 2: 1577-8(Oct 1970).

States in ^{57}Ni were observed at excitations of 2.45 ± 0.01 and 3.00 ± 0.01 MeV using the ^{58}Ni(^{3}He,α)^{57}Ni reaction, confirming previous indications of their existence from ^{54}Fe(α,nγ)^{57}Ni studies. (auth)

52535 MEAN LIFE MEASUREMENTS IN ^{29}P. Cummings, J. E.; Donahue, D. J. (Univ. of Arizona, Tucson). Phys. Rev., C; 2: 1570-2(Oct 1970).

The Doppler-shift attenuation method was used to obtain the mean lives of the first two excited states in ^{29}P: τ(1.38 MeV) = $(2.1 \pm 0.6) \times 10^{-13}$ sec and τ(1.95 MeV) = $(3.2^{+1.2}_{-0.7}) \times 10^{-13}$ sec. The excited states were populated by the reaction ^{28}Si(d,n)^{29}P using deuteron energies ranging from 2.93 to 3.50 MeV. Pulse-shape discrimination was employed for the neutron–γ coincidence measurements. The results were compared with those in ^{29}Si and with the predictions of the strong-coupling rotational model. (auth)

52536 (p,d) REACTIONS ON SILICON ISOTOPES AT 27.3 MeV. Pellegrini, F. (Istituto Nazionale di Fisica Nucleare, Padua); Gentilin, F.; Guazzoni, P.; Micheletti, S.; Pignanelli, M. Phys. Rev., C; 2: 1440-6(Oct 1970).

The neutron pick-up reactions ^{29}Si(p,d)^{28}Si and ^{30}Si(p,d)^{29}Si were studied at a bombarding proton energy of 27.3 MeV. Several angular distributions were analyzed with the distorted-wave Born approximation and the resulting spectroscopic factors and sum rule are given. The results indicate that the neutron configuration of the silicon isotopes contains $1d_{\frac{5}{2}}$, $2s_{\frac{1}{2}}$, and $1d_{\frac{3}{2}}$ components. A small f-wave neutron component was found in ^{30}Si. Strong $d_{\frac{3}{2}}$ transitions were observed to the unresolved doublet ($J^\pi = 3^+$, 2^+; T = 1) at 9.32 MeV in ^{28}Si and to the ($J^\pi = \frac{5}{2}^+$; T = $\frac{3}{2}$) level at 8.32 MeV in ^{29}Si. These states are the isobaric analogs to the states of ^{28}Al (0 and 0.031 MeV) and to the ground state of ^{29}Al, respectively. The $J^\pi = 4^+$ state at 4.61 MeV in ^{28}Si was excited in the ^{29}Si(p,d)^{28}Si reaction, indicating target excitation effects in single-nucleon-transfer reactions. (auth)

52537 NEUTRON EMISSION FROM THE ^{64}Zn COMPOUND NUCLEUS FORMED IN TWO WAYS: p + ^{63}Cu AND α + ^{60}Ni. Ahrens, Stuart T.; Simon, William G.; Eldridge, Hudson B. (Univ. of Wyoming, Laramie). Phys. Rev., C; 2: 1433-9 (Oct 1970).

The ^{64}Zn compound nucleus was formed at an excitation energy of 3.33 MeV using two different target-projectile systems: 26.0-MeV protons on ^{63}Cu and 31.3-MeV α particles on ^{60}Ni. Neutrons were detected with nuclear emulsions using the internal-radiator method. Exposures were made simultaneously at the following angles: 18, 33, 90, 147, and 162°. The c.m. energy spectra (2 to 15 MeV) of the two systems were very nearly the same. For both systems symmetry about 90° in the c.m. angular distributions was seen up to about 6 MeV followed by a forward peaking at higher energies. The symmetric (compound-nuclear) parts of the angular distributions differ significantly in anisotropy. For the p + ^{63}Cu system the distribution is essentially isotropic while for the α + ^{60}Ni system there is an average anisotropy of about 1.4. For the α + ^{60}Ni system a slight but significant increase in anisotropy with energy of the emitted neutron (1.290 ± 0.047 at 2 MeV to 1.649 ± 0.119 at 6 MeV) was observed. The changes in average anisotropy with changes in the target-projectile systems were basically consistent with multiple-emission calculations using a rigid-sphere moment of inertia (r_0 = 1.22 F). The change in anisotropy with emission energy was not seen in the calculations. It was estimated that, for the p + ^{63}Cu and α + ^{60}Ni systems, direct-reaction neutrons constitute 5 and 3% of the total observed neutron spectra. (auth)

52538 NUCLEAR ENERGY LEVELS OF ^{31}S AND ^{33}Cl. Moss, C. E. (California Inst. of Tech., Pasadena. Univ. of Colorado, Boulder). Nucl. Phys.; A145: 423-48(1970).

The reaction $^{32}S(^3He,\alpha)^{31}S$ has been used to locate 42 levels in ^{31}S. For 11 of the first 17 levels l_n values have been determined. The first 6 excited states of ^{31}S have been studied by applying the particle-gamma correlation method of Litherland and Ferguson (method II) to the reaction $^{32}S(^3He,\alpha\gamma)^{31}S$. The resulting spins and parities are: E_x, J^π = 1.25 MeV, $\frac{3}{2}^+$; 2.23 MeV, $\frac{5}{2}^+$; 3.08 MeV, $\frac{1}{2}^+$; 3.29 MeV, $\frac{5}{2}^+$, $(\frac{3}{2}^+)$; 3.35 MeV, $(\frac{1}{2},\frac{3}{2})$; 3.44 MeV, $\frac{3}{2}^{(+)}$. Mixing and branching ratios have also been determined. The ground state Q-value for the reaction $^{32}S(^3He,\alpha)^{31}S$ has been measured to be 5.538 ± 0.006 MeV. Analysis of the deuteron spectra of the reaction $^{32}S(^3He,d)^{33}Cl$ located levels in ^{33}Cl at the following excitation energies: 0, 810 ± 9, (1978 ± 14), 2351 ± 9, 2686 ± 8, 2848 ± 9 (a known doublet), 2980 ± 9 and 4119 ± 10 keV. The 2.0 MeV level was only weakly populated, and to confirm its existence the reaction $^{36}Ar(p,\alpha)^{33}Cl$ has been studied. In this reaction the 2.0 MeV level was strongly populated and the measured excitation energy was 1999 ± 20 keV. Some levels populated by the reactions $^{34}S(^3He,\alpha)^{33}S$ and $^{34}S(^3He,d)^{35}Cl$ were also observed. The experimental results for ^{31}S and ^{33}Cl are compared with their analogs and in the case of ^{33}Cl with nuclear model predictions. (auth)

52539 STRONG-ABSORPTION MODEL FOR SCATTERING OF HELIONS AND TRITONS. Rahman, M. (Atomic Energy Centre, Dacca, Pakistan); Ahmed, M. U.; Sen Gupta, H. M. Nuovo Cim.; 68A: 397-408(1 Aug 1970).

The 3-parameter strong-absorption model of Frahn and Venter is used to analyze the helion and triton elastic-scattering data from some nuclei between C and Sn. A satisfactory agreement is obtained in heavier nuclei, whereas the fit is rather poor in light nuclei. Interaction radius and surface diffuseness are obtained from the best-fit parameter values of T, Δ, and μ. Inelastic scattering of helions from ^{26}Mg, ^{56}Fe, ^{58}Fe and ^{60}Ni is also analyzed and the deformation parameter β_2 is obtained. (auth)

52540 DECAY OF ^{51}Cr. Ribordy, Cl.; Huber, O. (Univ., Freiburg i. B.). Helv. Phys. Acta; 43: 345-62(1 Jul 1970).

The decay of ^{51}Cr is studied with a Ge(Li) detector of 3.2 cm^3 and a double focusing beta spectrometer. Hypothetical transitions (150 keV, 325 keV, 470 keV, and 645 keV) in ^{51}V are excluded. The energy and K-internal conversion coefficient of the single γ-transition in ^{51}V are measured: E_γ = (320.032 ± 0.040) keV and α_K = (1.46 ± 0.13) × 10^{-3}. The Q value of the decay $^{51}Cr \rightarrow {}^{51}V$ is obtained from the end point energy of the internal bremsstrahlung (IB) spectrum: Q = (748 ± 14) keV. This IB spectrum is measured with a Ge(Li) detector and unfolded with a described procedure. Although a pile up rejector was used, this Ge(Li) measurement suffers still from a distortion due to the pile up effect. The IB spectrum taken with the magnetic spectrometer (pile up free) reveals a deformation which remains unclear. The proportion of the electron captures populating the first excited state of ^{51}V is measured: β = (10.2 ± 1)%. A decay scheme is proposed. (auth)

52541 POSSIBLE CASE OF VIOLATION OF THE INDEPENDENCE OF COMPOUND NUCLEUS DECAY OF THE INPUT CHANNEL SPIN. Karadzhev, K. V.; Man'ko, V. I.; Persesyan, A. N.; Chukreev, F. E. (Inst. of Atomic Energy, Moscow). JETP Lett. (USSR) (Engl. Transl.); 11: 53-6(20 Jan 1970).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 11: 88-92 (20 Jan 1970).

Measurements of the angular distributions of reactions on nuclei with nonzero spin uncover new possibilities of verifying the independence of the compound-nucleus decay method from the incident channel of the reaction. The case of a solitary resonance produced by the interaction between a nucleon and a target nucleus with spin is considered. If the partial nucleon widths Γ_b and Γ_c for the two open exit channels b and c do not depend on the incident channel, then independent measurements of the angular distributions for b and c should yield identical values for the spin mixing parameter t. For the reactions (p,p), (p,α), and (p,γ) on ^{31}P, t_p agrees with t_α, but there is a patent discrepancy with t_γ. This suggests that the decay of the compound nucleus depends on the incident channel, in particular, that the widths of the decay are different for the cases of level production with incident-channel spins S = 0 and S = 1. (R.W.R.)

52542 MEASUREMENT OF THE MAGNETIC MOMENTS OF THE MICROSECOND ISOMERS IN ^{73}As AND ^{204}Pb. Quitmann, D.; Jaklevic, J. M. (Univ. of California, Berkeley). Z. Naturforsch.; 25a: 975-6(Jun 1970).

The isomeric state of ^{73}As (426 keV, 5.8 μsec) was produced and aligned by the reaction $^{71}Ga(\alpha,2n)$ in a liquid metal target. The anisotropies of the depopulating γ-rays were measured vs. the dc magnetic field applied perpendicular to the beam-detector plane. From the attenuation and rotation, g = +1.03 ± 0.11 was obtained. Limits of $\delta^2 < 10^{-2}$ can be set to the multipole admixtures in both γ-transitions. The same technique was applied to the 123 μsec isomer of ^{206}Pb (2200 keV) produced by $^{204}Hg(\alpha,2n)$. After estimating the relaxation time, g = −(0.035 ± 0.020) is obtained. (auth)

52543 INADEQUACIES IN A CONVENTIONAL DISTORTED-WAVE BORN-APPROXIMATION ANALYSIS OF (p,t) TRANSITIONS IN TITANIUM ISOTOPES AT E_p = 27 MeV. Baer, H. W.; Kraushaar, J. J.; Moss, C. E.; King, N. S. P.; Green, R. E. L. (Univ. of Colorado, Boulder). Phys. Rev. Lett.; 25: 1035-40 (12 Oct 1970).

Some measurements of (p,t) differential cross sections are reported for which a conventional distorted-wave Born-approximation analysis does not work well, and where the findings suggest caution in the interpretation of (p,t) studies in the A = 50 mass region at a bombarding energy of about 27 MeV. (auth)

52544 ELECTRON SPIN DENSITY AND INTERNAL CONVERSION PROCESS. Morita, Masato (Osaka Univ.); Sugimoto, Kenzo; Yamada, Masami; Yokoo, Yoshimatsu. Progr. Theor. Phys. (Kyoto); 41: 996-1003(Apr 1969).

The spin density of orbital electrons was explored by utilizing the spin dependence of internal conversion processes. The relative intensity of internal conversion electrons was calculated for the case where the radial wave functions of the orbital electrons are different for spin up and spin down. As a particular example, the internal conversion process in the decay of the 14.4-keV level of ^{57}Fe was calculated by using the radial wave functions of the orbital electrons of Fe obtained in the unrestricted Hartree–Fock method which have a reasonable fit to the experimental data on the internal magnetic field. It is shown that the L_I and M_I conversion electrons distribute almost isotropically, and the intensity of conversion electrons should change by about 0.5% for L_I and 2% for M_I for different spin polarizations. (auth)

52545 GAMMA RAYS FROM THE DECAY OF ^{44}Sc, ^{44m}Sc, AND ^{48}Sc AND ENERGY LEVELS IN ^{44}Ca AND ^{48}Ti. Eisele, J. A.; Larson, R. E. (Naval Research Lab., Washington, D. C.). Radiochim. Acta. 14: 54-5(1970).

The energy of gamma rays from the decay of ^{44}Sc, ^{44m}Sc, and ^{48}Sc was measured and a crossover in the decay of ^{48}Sc observed. These isotopes were produced by (p,n) reactions on ^{44}Ca and ^{48}Ca. The decay schemes are shown. (M.C.G.)

Nuclear Properties and Reactions, A ≥ 90

Refer also to abstracts 50362, 50388, 50421, 50557, 50558, 50917, 51410, 52339, 52386, 52404, 52425, 52430, 52436, 52438, 52446, 52474, 52477, 52479, 52480, 52494, 52510, 52514, 52517–52519, 52539, 52542, 52644, 52650, and 52704.

52546 (AE-400) TABLE OF HALF-LIVES FOR EXCITED NUCLEAR LEVELS. Malmskog, Sven G. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Jul 1970. 32p. Dep. CFSTI (U. S. Sales Only).

The knowledge of the half-lives of excited states is often a valuable information in the investigation of the nuclear level structure. The present paper contains a collection of such half-lives being published in the current literature over the period 1967–1970. The data are arranged in increasing order of mass number. (auth) (Sweden)

52547 (AEET/HP/Th-16) DATA ON THE NUCLEAR PROPERTIES OF ^{235}U FISSION PRODUCTS. Iyer, M. Ramakrishna; Ganguly, A. K. (Atomic Energy Establishment, Trombay (India)). 1964. 88p. Dep. CFSTI (U. S. Sales Only).

A compilation of 315 fission products both stable and unstable whose existence is known or suspected is presented. The compilation includes new experimental information on the γ spectra of certain fission products like ^{85}Kr, and ^{133}Xe. The γ decay energies of 22 short-lived fission products are estimated theoretically. Improved values of γ energy data are available for certain fission products. (10 references) (auth)

52548 (AEET/HP/Th-17) GAMMA ENERGY RELEASE RATES FROM FISSION PRODUCTS AT SHORT TIMES AFTER FISSION. Iyer, M. Ramakrishna; Ganguly, A. K. (Atomic Energy Establishment, Trombay (India). Health Physics Div.). 1964. 23p. Dep. CFSTI (U. S. Sales Only).

The gamma energy release rates from fission product mixtures have been theoretically estimated by various workers. Many of these attempts are limited to post-fission times of a few minutes and afterwards. This is mainly because of the limitation of input data. The disagreement between the calculated and experimental values is considerable at cooling times less than 1000 seconds. Improvement upon the existing computed values of gamma energy release rates is made by including information on more fission products—mainly short-lived ones. A compilation of data on the nuclear properties of uranium-235 fission products is made. 315 fission products both stable and unstable whose existence is known or suspected are included in the compilation. Due to the absence of experimental information, the gamma decay energies of 22 short-lived fission products are theoretically computed using beta decay theory and nuclear shell model. A ten group classification of fission product gamma energy is adopted to present the gamma spectrum. The groupings are arrived at from the point of view of dose computation. Gamma energy release rates, photon emission rates and weighted average energy are studied in each group and the suitability of the groupings discussed. 11 references. (auth)

52549 (BNL-tr-367) AVERAGE CHARACTERISTICS OF THE PROBABILITY RATIO FOR CAPTURE AND FISSION IN THE RESONANCE AND EPIRESONANCE REGION. Abagyan, L. P.; Nikolaev, M. N.; Rabotnov, N. S.; Usachev, L. N. Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from Anglo-Soviet Seminar on Nuclear Constants for Reactor Calculations, Duhna, 18–22 June 1968. 16p. (CONF-680669-1). Dep. CFSTI.

The discrepancies in values of α for ^{239}Pu in the 1 to 20 keV energy region are investigated. The calculations presented are based on accounting for fluctuations in the individual fission and neutron widths by considering the fluctuations in the average widths. 14 references. (H.D.R.)

52550 (CEA-N-1313) RECONSTITUTION BY CALCULATION OF THE SPECTRA OF γ RAYS EMITTED BY FISSION PRODUCTS. Barre, Bertrand (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jun 1970. 94p. (In French). Dep. CFSTI (U. S. Sales Only).

The theoretical reconstitution of the γ ray spectra fission products for cooling times of between 1 and 10^8 seconds after the thermal fission of a ^{235}U nucleus is presented; this is done from the calculation of fission product concentrations using the PEPIN-LE-BREF code. The CSET programme which makes this reconstitution is intended to facilitate the interpretation of experimentally measured spectra. The nuclides mainly responsible for the γ activity up to 10^4 seconds after a fission are found to be those which have unknown decay processes. 6 references. (auth) (France)

52551 (CONF-690916-(Vol.1), pp 4-22) CURRENT STATUS OF NUCLEAR FISSION STUDIES. Kapoor, S. S.; Ramanna, R. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23–26, 1969. Vol. I.

The present status of understanding of the fission process is summarized. The different stages in fission, emission of prompt radiation, distribution of fragment mass and charge, and consequences of shell effects on fission barrier are discussed. (M.C.G.)

52552 (CONF-690916-(Vol.1), pp 182-90) KINETIC ENERGY RELEASE IN THE NEUTRON-INDUCED FISSION OF ^{233}U AND ^{239}Pu. Dange, S. P.; Manohar, S. B.; Prakash, Satya; Ramaswamy, A.; Ramaniah, M. V. (Bhabha Atomic Research Centre, Bombay (India)).

From Proceedings of the chemistry symposium, Chandigarh, September 23 26, 1969. Vol. I.

The kinetic energy distribution in the thermal fission of ^{233}U and ^{239}Pu was studied using radiochemical techniques. Ranges of recoils were measured and converted to kinetic energies. Data are presented in tables and graphs. (M.C.G.)

52553 (COO-1746-40) GAMMA-GAMMA DIRECTIONAL CORRELATION MEASUREMENTS IN ^{124}Te. Grabowski, Z. W.; Krane, K. S.; Steffen, R. M. (Purdue Univ., Lafayette, Ind.). [1970]. 5p. (CONF-700807-3). Dep. CFSTI.

From Conference on Angular Correlations in Nuclear Disintegration, Delft, The Netherlands.

The 723γ – 603γ directional correlation was measured using a combination of coaxial Ge(Li)–NaI(Tl) and two coaxial Ge(Li) detectors. The coincidence rate was determined at seven angles and corrected for chance coincidences, coincidences caused by competing cascades, and the finite solid angle of the detectors. The energy resolution of the Ge(Li) detectors was better than 3.5 keV. The weighted average for the E2/M1 mixing ratio obtained from these measurements is $\delta_{723} = -3.4 \pm 0.1$, and thus the K-conversion coefficient for the 723-keV transition in ^{124}Te is $\alpha_K(723) = 2.7 \times 10^{-3}$. The 646$\gamma$ – 603γ, 1691γ – 603γ, and 2091γ – 603γ directional correlations in ^{124}Te were also measured. The spin I = 4 assignment is made for the 1249-keV level. The 2294- and 2694-keV levels are assigned the spin 3$^-$, with the 1691- and 2091-keV transitions being essentially pure E1. (R.W.R.)

52554 (COO-1746-47) EXPERIMENTAL TEST OF THE KUMAR–BARANGER PAIRING-PLUS-QUADRUPOLE FORCE MODEL IN THE A = 190 REGION THROUGH E2-M1 MIXING AMPLITUDES. Krane, K. S.; Steffen, R. M. (Purdue Univ., Lafayette, Ind. Nuclear Structure Lab.). [1970]. Contract AT(11-1)-1746. 26p. Dep. CFSTI.

The E2/M1 multipole mixing ratios δ (γ) of gamma transitions in even–even osmium and platinum isotopes have been measured in order to test the predictions of the pairing-plus-quadrupole theory of Kumar and Baranger. The mixing ratios δ (γ) were determined from directional correlation measurements on gamma transitions in ^{188,189,190}Os (populated in the decay of ^{188,189,190}Ir) and in ^{194,196}Pt (populated in the decay of ^{194,196}Au). The radioactive iridium isotopes were produced by Re(α,xn) reactions and the gold isotopes were produced by Pt(d,xn) reactions. The equipment employed for the gamma–gamma directional correlation measurements consisted of two coaxial 30-cc Ge(Li) detectors and appropriate electronic equipment for high-resolution pulse-height analysis and timing analysis. The observed directional correlations were analyzed in terms of the appropriate E2/M1 mixing ratios, which are defined explicitly. The following results were obtained (predictions of the Kumar–Baranger theory are listed in square brackets): δ (^{188}Os, 630 keV) = -10^{+15}_{-6} [–14.7], δ (^{188}Os, 773 kev) = -13^{+8}_{-4} [–13.5], δ (^{188}Os, 478 keV) = –12.3 ± 2.8 [–9.5], δ (^{189}Os, 635 keV) = –6.9 ± 3.2 [–10.5], δ (^{190}Os, 371 keV) = –8.5 ± 1.0 [–7.6], δ (^{190}Os, 569 kev) = –9.0 ± 1.5 [–9.9], δ (^{194}Pt, 293 keV) = +14.3 ± 2.1 [+19.9], δ (^{196}Pt, 333 keV) = –5.7 ± 0.3 [–101.4]. Except for the 333 keV transition in ^{196}Pt the agreement of the experimental mixing ratios with the values and signs predicted by the Kumar–Baranger model is excellent. (auth)

52555 (EURFNR-806) REEVALUATION OF GOLD SHELL TRANSMISSION DATA AT 24-keV NEUTRON ENERGY. Froehner, F. H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Jun 1970. 6p. (KFK–1228; CN–26/9; CONF-700605–8). Dep. CFSTI (U. S. Sales Only).

Work Performed under United States–Euratom Fast Reactor Exchange Program.

From 2nd International Conference on Nuclear Data for Reactors, Helsinki, Finland.

Quite different values of the 24-keV neutron capture cross section of gold have been extracted by various authors from the shell transmission data reported by Schmitt and Cook. The discrepancies are due to the different treatment of the rather important self-shielding and multiple-scattering corrections. A new attempt to calculate them was based on the best available total cross section data and level statistics. Monte Carlo methods were used to generate resonance cross sections. The result is σ_γ(24 keV) = (650 ± 35)mb. Implications for the present gold standard situation are discussed. (auth)

52556 (EURFNR-807) TEMPERATURE DEPENDENCE OF THE AVERAGE TRANSMISSION OF GOLD. Schneider, E.; Froehner, F. H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Jun 1970. 15p. (KFK–1229; CN–26/10; CONF-700605–10). Dep. CFSTI (U. S. Sales Only).

Work Performed under United States–Euratom Fast Reactor Exchange Program.

From 2nd International Conference on Nuclear Data for Reactors, Helsinki, Finland.

The average neutron transmission of gold was measured with fairly thick samples between 10 and 60 keV at 11°C and at 800°C. The observed temperature effect is caused by thermal expansion of the sample (which enhances the transmission) and by Doppler broadening of resonances (which tends to lower it on the average). The experimental data were used to check the adequacy of various methods for the calculation of resonance cross sections from level statistics. In particular, one- and multi-level R-matrix representations were tested. (auth)

52557 (INDC(NDS)-18/N) CURRENT STATUS OF ^{238}U CAPTURE CROSS-SECTION DATA IN THE NEUTRON ENERGY REGION 2 keV TO 10 MeV. Konshin, V. A. (International Nuclear Data Committee). Mar 1970. 17p. Dep. CFSTI (U. S. Sales Only).

The results of recent ^{238}U capture cross section measurements are evaluated. The following criteria were applied in analyzing the experimental results: greater weight was attached to new experimental results; the chosen ^{238}U capture cross section value was the one used as reference cross section for subsequent renormalization; the reference shape of the capture cross section curve was chosen; and data not in agreement with the reference shape of the curve were rejected. The weighted mean capture cross section value for ^{238}U at 30 keV was used as reference cross section value. (29 references) (auth)

52558 (IS-T-350) LIFETIMES OF THE FIRST EXCITED STATES IN ^{169}Tm, ^{171}Tm, AND ^{134}Cs. Turner, Charles Edward Jr. (Ames Lab., Iowa). Aug 1970. Contract W-7405-eng-82. 163p. Dep. CFSTI.

Thesis.

A careful experimental investigation was carried out in order to provide values of convincing accuracy for the lifetimes of the 8.4-keV level in ^{169}Tm and the 5.0-keV level in ^{171}Tm in view of existing experimental discrepancies. The objective was to determine whether or not the general disagreement with the rotational model predictions for these lifetimes could be removed. The half-life values determined by $e^- - e^-$ delayed-coincidence measurements utilizing magnetic energy discrimination and electrostatic preacceleration techniques were found to be (4.04 ± 0.06) nsec and (4.77 ± 0.08) nsec for the 8.4-keV level in ^{169}Tm and the 5.0-keV level in ^{171}Tm, respectively. These values are in good agreement with the predictions of the rotational model for the lifetime of a first-excited rotational state based on a ground-state Nilsson $\frac{1}{2}$ + [411] orbital in ^{169}Tm and ^{171}Tm, respectively. Special treatment is given to the principal sources of systematic error. Transmission loss and its partial restoration for very-low-energy electrons under preacceleration in an intermediate-image spectrometer is discussed along with a description of techniques used to achieve efficient detection of very-low-energy electrons with a plastic scintillator. An electronic system is described which combines low level timing, pileup rejection, digital stabilization, and semi-automatic electronic time calibration. An optimum time resolution (FWHM) of 1.2 nsec has been achieved with 28-keV electrons in one coincidence channel and 113-keV electrons in the other. The differential nonlinearity of the combined TAC, biased amplifier, and MCPHA system was carefully measured and used to numerically correct the experimental time distributions to channels of constant width. The delayed-coincidence distributions were analyzed, with consistent results, by three methods: logarithmic slope analysis, exponential tail fit analysis, and very accurate maximum-likelihood unfolding based on an experimentally measured prompt curve. Indications of a systematic discrepancy with earlier measurements in ^{169}Tm and ^{171}Tm led to remeasurement by similar techniques of the half-life of the 11-keV level in ^{134}Cs. The result of (45.7 ± 1.2) nsec reinforced the evidence for a systematic discrepancy. (auth)

52559 (JINR-E6-5197) LONG LIVED STATES IN ^{204}Po AND ^{206}Po. Broda, R.; Chojnacki, S.; Droste, Ch.; Morek, T.; Walus, W. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1970. 11p. Dep. CFSTI (U. S. Sales Only).

Information obtained from a study of the decay of ^{204}At and ^{206}At used to construct a level scheme for ^{204}Po and ^{206}Po. In both nuclei there were found long-lived states. They are 143 nsec in ^{204}Po and 212 nsec in ^{206}Po. These states are identified as the 8+ member of the band of levels resulting from the proton configuration $(h_{9/2})^2$. (auth)

52560 (JINR-P6-5201) INVESTIGATION OF HALF-LIVES OF 2^+ AND 4^+ LEVELS OF THE MAIN AND ROTATIONAL BAND IN EVEN-EVEN NUCLEI OF Os, Er, Dy. Morozov, V. A.; Muminov, T. M.; Khalikulov, A. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1970. 15p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The half-lives are measured for the first excited levels 2^+ and 4^+ in the nuclei $^{166}Dy(T_{1/2}(2+) = 0.90 \pm 0.08$ nsec), $^{168}Dy(T_{1/2}(2+) = 1.63 \pm 0.08$ nsec), $^{160}Dy(T_{1/2}(2+) = 1.76 \pm 0.08$ nsec), $T_{1/2}(4+) = 95 \pm 10$ nsec), $^{162}Er(T_{1/2}(2+) = 1.17 \pm 0.10$ nsec), $^{164}Er(T_{1/2}(2+) = 1.48 \pm 0.08$ nsec), $^{166}Er(T_{1/2}(2+) = 1.99 \pm 0.09$ nsec) $T_{1/2}(4+) = 111 \pm 10$ nsec), and $^{184}Os(T_{1/2}(4+) = 46 \pm 13$ nsec). (auth)

52561 (LA-4385-TR) PHOTOFISSION OF ^{232}Th, ^{234}U, ^{238}Pu, ^{240}Pu, AND ^{242}Pu AND STRUCTURE OF THE FISSION BARRIER. Rabotnov, N. S.; Smirenkin, G. N.; Soldatov, A. S.; Usachev, L. N.; Kapitsa, S. P.; Tsipeniuk, Yu. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). Translated by Helen J. Dahlby (Los Alamos Scientific Lab., N. Mex.), from report FEI-170. 16p. Dep. CFSTI.

Measurements of the angular distributions and fragment yields for photofission of the even-even nuclei ^{232}Th, ^{234}U, ^{238}Pu, ^{240}Pu, and ^{242}Pu near the threshold are reported. Measurements were made in a beam of bremsstrahlung gamma quanta in the 12-MeV microtron of the Institute of Physical Problems of the Academy of Sciences of the USSR in the region of maximum energies, E_{max}, from 5 to 10 MeV. Calculation of the bremsstrahlung spectrum from a 1-mm tungsten target used to reduce the dependence of the total photofission cross section and its angular components on the energy, E, of the gamma quanta is described. The results, which do not fit traditional concepts, indicate the existence of a double-humped fission barrier. (23 references) (auth)

52562 (NEDO-12037) SUMMARY OF GAMMA AND BETA ENERGY AND INTENSITY DATA. Meek, M. E.; Gilbert, R. S. (General Electric Co., Pleasanton, Calif. Nucleonics Lab.). Jan 1970. 56p. (69-NED-41).

The decay characteristics of the volatile fission and activation products observed in operating reactors and genetically related nuclides were compiled from the current literature. Values for the energy and absolute intensity of the individual beta and gamma transitions reported are presented for identifying nuclides, absolute counting, and calculating energy release. (auth)

52563 (NP-18217) IPCR CYCLOTRON PROGRESS REPORT, 1969. Volume 3. (Institute of Physical and Chemical Research, Tokyo (Japan)). Dec 1969. 125p.

Research conducted at the cyclotron laboratory of the Institute for Physical and Chemical Research during 1969 is described. The research encompassed various studies in machine development and accelerator physics, nuclear instrumentation development, nuclear scattering and reactions, nuclear spectroscopy, radiochemistry, radiation chemistry, solid-state physics, radioisotope production and applications, and radiation monitoring. (J.W.R.)

52564 (NP-18447) EVEN-EVEN ISOTOPES OF TELLURIUM. Lagrange, Jean-Marie (Paris Univ., Orsay (France). Faculte des Sciences). 1970. 102p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis.

Even-even isotopes of tellurium of masses between 122 and 130 were studied by Coulomb excitation. The results obtained yielded various quantitative information about quadrupole and octupole excitation within the nuclei. The application of classical nuclear spectroscopy tothe study of the radioactivity of the corresponding isobars of iodine and antimony led to the completion of the nuclear level schemes of ^{124}Te and ^{122}Te and to the proposal of nuclear level schemes for ^{120}Te and ^{118}Te. The principal characteristics of the theoretical treatment of the nondeformed even-even nuclei were then elucidated. The microscopic calculations describing the collective quadrupole and octupole excitations, and the semimicroscopic (intermediate coupling core-particle) calculations which were capable of giving good agreement up to about 2 MeV, were analyzed individually. The results obtained by the two methods for the electric quadrupole and octupole transitions probabilities and for the energy, total angular momentum, parity and mode of loss of excitation energy were compared with the theoretical predictions for the two types of model. (auth) (France)

52565 (NP-18461) STUDY OF THE ELASTIC AND INELASTIC SCATTERING OF 156-MeV PROTONS BY EVEN-EVEN ISOTOPES OF TIN. Comparat, Vincent (Paris Univ., Orsay (France). Faculte des Sciences). 1970. 57p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The scattering of 156-MeV protons by ^{116}Sn, ^{118}Sn, and ^{120}Sn was studied. The experimental equipment and the results obtained for the scattering cross sections are presented. The elastic scattering is interpreted in terms of the optical model; two rapid methods for interpreting the inelastic scattering are then described. The nuclear wave functions arising from three different calculations using the quasi-particle formalism are used; the usefulness of the DWIA as a tool for studying nuclear models is demonstrated. Experimental and theoretical results are compared, and information concerning the nuclear wave functions obtained. (France)

52566 (ORNL-4534) ELECTRONUCLEAR DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1969. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. 135p. Dep. CFSTI.

ALPHA PARTICLES—reactions (α,T) with deuterium at 82 MeV, charge symmetry and cross sections for, (E)
ALUMINUM—electron reactions at 5.0 GeV, (E)
ARGON-35—energy levels of, (T)
CARBON-12—energy levels of

—helium-3 reactions (^{3}He,n) at 25 MeV, angular distributions and cross sections for, (E)
CARBON-14—proton reactions (p,n) at 20 and 30 MeV, cross sections for, (E)
—helium-3 reactions (^{3}He,t) at 25 MeV, cross sections for, (E)
CHLORINE-35—energy levels of, (T)
COBALT-59—helium-3 elastic scattering at 50 MeV, (E)
COPPER—deuteron reactions at 20 and 40 MeV, radioisotope production in, (E)
CYCLOTRONS—development of APACHE heavy-ion four-sector isochronous
DEUTERIUM—alpha reactions (α,T) at 82 MeV, charge symmetry and cross sections for, (E)
DEUTERONS—reactions with hydrogen at 19.8, 29.6, and 41.1 MeV, angular distributions and cross sections for, (E)
—reactions with copper at 20 and 40 MeV, radioisotope production in, (E)
—reactions (d,d) and (d,t) with helium-3 at 39 MeV, cross sections for, (E)
DYSPROSIUM-156—helium-3 reactions at 100 MeV, properties of isotopes produced in, (E)
ELECTRONS—reactions with aluminum, iron, and tantalum at 5.0 GeV, (E)
—reactions with iron at 40 MeV to 16 GeV, radioisotope production in, (E)
ELECTRON MICROSCOPES—development of high resolution, with superconducting lenses
ERBIUM-151—production by helium-3 reactions with dysprosium-156 at 100 MeV, (E)
ERBIUM-158—electron capture decay of, conversion electron spectrum for, (E)
EUROPIUM-145—energy levels from gadolinium-145 decay, (E)
GADOLINIUM-145—decay of, gamma spectra from, (E)
HELIUM-3—deuteron reactions (d,d) and (d,t) at 39 MeV, cross sections for, (E)
—reactions (^{3}He,n) with carbon-12 at 25 MeV, angular distributions and cross sections for, (E)
—reactions (^{3}He,t) with carbon-14 at 25 MeV, cross sections for, (E)
—reactions with dysprosium-156 at 100 MeV, properties of isotopes produced in, (E)
—scattering by cobalt-59 and nickel-60 at 50 MeV, elastic, (E)
HYDROGEN—proton scattering at 65 MeV, bremsstrahlung from, (E)
—deuteron reactions at 19.8, 29.6, and 41.1 MeV, angular distributions and cross sections for, (E)
IRON—electron reactions at 5.0 GeV, (E)
—electron reactions at 40 MeV to 16 GeV, radioisotope production in, (E)
NEODYMIUM ISOTOPES—proton reactions (p,t) at 32 MeV, (E)
NICKEL-60—helium-3 elastic scattering at 50 MeV, (E)
NUCLEAR PHYSICS—research progress on
NUCLEAR STRUCTURE—theory of, research progress on
NUCLEI—proton reactions with N = 82, (E/T)
ISOCHRONOUS CYCLOTRON—development and operation, 1969
OXYGEN-14—energy levels from carbon-12(^{3}He,n) reactions, (E)
PROTONS—scattering by hydrogen at 65 MeV, bremsstrahlung from, (E)
—reactions with N = 82 isotones, (E/T)
—reactions (p,n) with carbon-14 at 20 and 30 MeV, cross sections for, (E)
—reactions (p,t) with neodymium isotopes at 32 MeV, (E)
—reactions with even samarium isotopes at 50 MeV, cross sections for, (E)
RADIOISOTOPES—production by electron reactions with iron at 40 MeV to 16 GeV, (E)
RUTHENIUM-95—energy levels of
SAMARIUM ISOTOPES—proton reactions with even, at 50 MeV, cross sections for, (E)
TANTALUM—electron reactions at 5.0 GeV, (E)
TERBIUM-151—alpha decay of, half-life for, (E)
TITANIUM-44—energy levels of, (E/T)
YTTERBIUM-156—production by helium-3 reactions with dysprosium-156 at 100 MeV, (E)
YTTERBIUM-157—production by helium-3 reactions with dysprosium-156 at 100 MeV, (E)
YTTRIUM-90—energy levels of, (E/T)
ZINC-62—production by deuteron reactions with copper, (E)
ZINC-63—production by deuteron reactions with copper, (E)
ZINC-65—production by deuteron reactions with copper at 20 and 40 MeV
ZIRCONIUM-91—energy levels of, (E/T)
ZIRCONIUM-92—energy levels of, (E/T) (M.C.G.)

52567 (ORNL-tr-2294) THE DECAY OF ^{180}Ta. Eberhardt, P.; Geiss, J.; Lang, C.; Herr, W.; Merz, E. Translated by Lynda H. Kern (Oak Ridge National Lab., Tenn.), from Z. Naturforsch.; 10A: 796-(1955). 4p. Dep. CFSTI.

The weight ratio, W/Ta, was quantitatively determined by chemical means for two old South African tantalite samples. The isotopic ratio was measured mass spectrometrically, and the isotopic ratio in WO_3 samples was determined by the same manner for comparison. Age estimations were then used to calculate an upper limit of the decay constant for β^- decay of ^{180}Ta. In addition, the log H value was estimated. (J.W.R.)

52568 (TID-25351) EXPERIMENTAL AND THEORETICAL INVESTIGATION OF NUCLEAR FISSION INDUCED BY LOW-ENERGY NUCLEAR PARTICLES. Progress Report. Deutsch, R. W. (Catholic Univ. of America, Washington, D. C. Dept. of Nuclear Science and Engineering). 1 Feb 1970. Contract AT-(40-1)-3951. 14p. Dep. CFSTI.

An experimental program to measure the excitation functions and halflives of spontaneous fission emitters has been started at the Nuclear Defense Laboratory, using the 15-MeV Tandem Van de Graaff facility. The experimental arrangement to be used for these measurements has been thoroughly reviewed and the necessary electronic equipment has been ordered. The remainder of the contract period will be concerned with collimation, alignment and electronics check-out problems, prior to carrying out measurements of protons and deuterons incident on ^{238}U, ^{239}Pu, ^{240}Pu and ^{241}Pu. The analysis of fission fragment characteristics resulting from thermal neutron fission of ^{233}U, ^{235}U and ^{239}Pu was completed. Similar analysis is being carried out as a function of neutron energy for ^{235}U, using improved theoretical models. (auth)

52569 EFFECTIVE CAPTURE AND FISSION CROSS SECTIONS FOR ^{253}Cf. Bemis, C. E. Jr.; Druschel, R. E.; Halperin, J. (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng.; 41: 146-7(Jul 1970).

The reactor capture cross section of 17.81-day ^{253}Cf was measured by examining the amount of 60.5-day ^{254}Cf produced in a reactor irradiation of ^{253}Cf. An approximate value for the total neutron-absorption cross section for ^{253}Cf was determined from its burnout in the irradiation. The sample was subjected to a thermal-neutron fluence of 2.94×10^{19} neutrons/cm^2, and the measured ratio of thermal- to resonance-neutron flux per unit lethargy was 9.58 at the sample position. The value found for the thermal neutron capture cross section for ^{253}Cf was 17.6 ± 1.8 b, with an uncertainty of 10%. A comparison of the change in the ratio of the α decay rates of ^{252}Cf relative to ^{253}Cf for the measurement of the irradiated and unirradiated samples indicated that (7.7 ± 1.2%) of the ^{253}Cf was transmuted during the irradiation. This implies an effective absorption cross section of 2550 ± 400 b, which is entirely attributable to neutron-induced fission. The value of 145 for the effective fission-to-capture cross-section ratio for ^{253}Cf is larger by a factor of 10 than any other measured value for this ratio for lower mass nuclides. (R.W.R.)

52570 PROMPT GAMMA RAYS FROM THERMAL NEUTRON FISSION OF ^{235}U. Peelle, R. W.; Maienschein, F. C. (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng.; 40: 485-6(Jun 1970).

The energy spectrum of gamma rays observed in coincidence with the fission of ^{235}U by thermal neutrons is presented for gamma-ray energies from 0.01 to 10.5 MeV in 17 energy groups. The integral yield gives an average energy per gamma ray of (0.89 ± 0.05) MeV over the gamma-ray energy range from 0.01 to 10.5 MeV. An approximation for the energy region from 0.01 to 0.6 MeV, which may be adequate for shielding calculations, is the emission of 3.75 photons/fission of average energy 0.324 MeV. (R.W.R.)

52571 USE OF ^{252}Cf AS A RANDOMLY PULSED NEUTRON SOURCE FOR PROMPT NEUTRON DECAY MEASUREMENTS. Mihalczo, John T. (Union Carbide Corp., Oak Ridge, Tenn.). Nucl. Sci. Eng.; 41: 296-8(Aug 1970).

The use of ^{252}Cf as a randomly pulsed neutron source is described, and a few preliminary results on uranium are presented. Spontaneous fission is of course a random source but, because the time that the neutron was emitted was known, the source could be considered a randomly pulsed source. The ionization pulse produced by the products of spontaneous fission triggered a time analyzer. The signals from a counter, which detected the leakage neutrons from the decaying fission chains initiated by ^{252}Cf decay, were sorted by the time analyzer and thus the prompt neutron time behavior was determined. This technique allows measurement of prompt neutron decay without a complicated pulsed neutron source and at a much faster rate than the Rossi-α type procedure.

This technique agrees with the Rossi-α method to within a few percent. (R.W.R.)

52572 LIFETIMES OF EXCITED STATES OF ^{217}At. Alkhazov, G. D.; Zalite, Yu. K.; Andersen, M. L.; Nielsen, O. B. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.); 12: 4-5(5 Jul 1970).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 12: 7-9 (5 Jul 1970).

The lifetimes of two excited states of ^{217}At were measured by the delayed-coincidence method. The α particles from ^{221}Fr decay were detected by a Si detector with resolution of 25 keV (fwhm); the conversion electrons were detected by a plastic scintillator and photomultiplier. Several methods of data reduction yielded the same result for the 218-keV level in ^{217}At: $T_{\frac{1}{2}}(218\ \text{keV}) = (2.7 \pm 0.2) \times 10^{-10}$ sec. The lifetime for the 99-keV level was found to be less than 5×10^{-10} sec. The procedure was verified by obtaining the accepted value for the lifetime of the 241-keV level in ^{220}Rn. (R.W.R.)

52573 ANGULAR ANISOTROPY OF THE FISSION OF ^{204}Pb AND ^{206}Pb BY ALPHA PARTICLES NEAR THE THRESHOLD. Kuvatov, K. G.; Okolovich, V. N.; Smirenkin, G. N. (Nuclear Physics Inst., Alma-Ata, USSR). JETP Lett. (USSR)(Engl. Transl.); 11: 26-8(5 Jan 1970).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu; 11: 42-6(5 Jan 1970).

Targets of ^{204}Pb and ^{206}Pb were bombarded with alpha particles degraded to 29 to 38 MeV. The fission cross sections and the angular distributions of the fragments were measured simultaneously, and the angular anisotropies of the fission of ^{208}Po and ^{212}Po were determined. The values for the energy gap Δ_f in the spectra of the internal excitations of ^{208}Po, ^{210}Po, and ^{212}Po were determined theoretically from estimates of the energy of the phase transition from the superfluid state into the Fermi-gas state. The results were 0.8 to 1.1 MeV, in contrast to the value 4 MeV reported previously for ^{210}Po. The energy gap is found to have a weak dependence on the deformation of the nucleus in the fission process. (R.W.R.)

52574 EXPERIMENTAL INVESTIGATION OF ABSORPTION IN THE 1.056 eV RESONANCE OF ^{240}Pu. Hulka, Charles J.; Woodruff, Gene L. (Univ. of Washington, Seattle). Nucl. Sci. Eng.; 41: 294-6(Aug 1970).

An experiment which provides a spectral index that is very sensitive to ^{240}Pu resonance absorption is described. This technique allows one to determine that part of the activation of a foil which results from the major resonances alone. The method entails the irradiation of thin iridium foils and the determination of the induced activities of the ^{192}Ir and ^{194}Ir isotopes. Since natural iridium consists of two isotopes, ^{191}Ir and ^{193}Ir, which have major resonances at 0.654 and 1.303 eV, respectively, it is useful as a detector for determining the relative fluxes immediately adjacent to the 1.056-eV resonance of ^{240}Pu. The calculated flux ratios for the 0.654- and 1.303-eV states agree with the measured values. The same is true for the "pseudo-resonance escape probability," defined as the flux ratio divided by the corresponding ratio calculated for a plutonium assembly having no ^{240}Pu but otherwise identical. While not exactly the same as the true resonance-escape probability, this parameter is useful as a rough index to the fraction of neutrons that escape the 1.056-eV resonance. (R.W.R.)

52575 PHOTON CROSS SECTIONS OF URANIUM AND PLUTONIUM. Atwater, H. F. (Los Alamos Scientific Lab., N. Mex.). Nucl. Sci. Eng.; 40: 487-8(Jun 1970).

The total photon cross sections of uranium and plutonium were calculated at energies from 1 to 600 keV, including the upper and lower cross-section values at the K edge, the L and M edges, and the N_1 edge. In this energy region the total cross section is given by the sum of the photoelectric cross section, the total incoherent cross section for a bound electron, and the coherent scattering cross section. Each of these components was separately calculated. The accuracy of the results (based on comparison with experimental values) is estimated to be 2% along the smooth portions of the cross-section curve and at the K and L edges. At the M edges and the N_1 edge, where the photoelectric cross section varies rapidly with energy, the accuracy is estimated to be 2 to 8%. (R.W.R.)

52576 ANGULAR ANISOTROPY AND SPIN OF THE TARGET NUCLEUS IN (n,f) REACTIONS. Smirenkin, G. N.; Shpak, D. L.; Ostapenko, Yu. B.; Furson, B. I. (Inst. of Radiophysics and Electronics, Kiev). JETP Lett. (USSR) (Engl. Transl.); 11: 333-6(20 May 1970).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 11: 489-93(20 May 1970).

The effect of target spin in fission induced by fast neutrons was investigated for the targets ^{233}U, ^{235}U, and ^{239}Pu. Glass detectors were used for measurements of the angular distributions of the fission fragments. The values of the angular anisotropy for ^{233}U and ^{239}Pu coincided within experimental error, while the value for ^{235}U was appreciably different. This disparity, as well as the absence of the spin effect at high excitations, is explained theoretically. (R.W.R.)

52577 DERIVATION OF ^{239}Pu RESONANCE PARAMETERS FROM CORRELATION OF EXPERIMENTAL DATA. Evatt, R. N.; Hutchins, B. A. (General Electric Co., Sunnyvale, Calif.). Nucl. Sci. Eng.; 41: 143-6(Jul 1970).

Single-level Breit-Wigner statistical parameters for ^{239}Pu resonances have been derived from high-resolution experimental data on alpha, the capture-to-fission cross section ratio; the fission cross section; and the total cross section. A set of "best" s-wave resonance parameters was derived from these data. P-wave cross sections and alphas were extracted from the data using the s-wave cross sections, and these results showed good agreement with theoretical analyses. The parameters reported will produce total and fission cross sections and alphas which are in good agreement with experimental results up to 5 keV. (R.W.R.)

52578 STUDIES OF THE NUCLEAR LEVELS OF ^{216}At. Briand, Jean-Pierre; Chevallier, Pierre; Touati, Alain (Paris Univ.). Compt. Rend., Ser. B; 271: 162-4(15 Jul 1970). (In French).

The nuclear levels of ^{216}At excited in the α disintegration of ^{220}Fr are studied by direct α and γ spectrometry and by (α, γ) and (γ, α) coincidence techniques using a Ge–Li solid state detector and an NaI scintillator. (France)

52579 ALPHA BRANCHING RATIO OF ^{227}Ac. Kirby, H. W. (Mound Lab., Miamisburg, Ohio). J. Inorg. Nucl. Chem.; 32: 2823-37(Sep 1970).

The alpha branching ratio of ^{227}Ac was determined by two independent methods. The intermediate means from the two methods were in good agreement: (1.3802 ± 0.0069) per cent and (1.3799 ± 0.0045) per cent. The weighted grand mean from 12 determinations was (1.3800 ± 0.0036) per cent. A computational technique was developed and tested which is believed to be useful as a nondestructive analytical tool for the determination of ^{227}Ac by alpha spectrometry in the presence of interfering decay products. (auth) (UK)

52580 DECAY OF ^{230}Pa. Lourens, W.; Ten Brink, B. O.; Wapstra, A. H. (Univ. of Tech., Delft, Netherlands). Nucl. Phys.; A152: 463-80(1970).

The radioactive decay of ^{230}Pa has been investigated with Ge(Li) and Si(Li) detectors. Forty-three gamma rays have been found. Three new levels in ^{230}Th and three in ^{230}U are suggested. A determination of the end-point energy of the electron branch to ^{230}U has been carried out. X-ray–gamma coincidences have been performed in order to determine the decay energy to ^{230}Th. The proposed disintegration scheme is compared with previously reported experimental results and with theoretical predictions. (auth)

52581 POLARIZATION EFFECTS IN DEUTERON STRIPPING REACTIONS ON ^{207}Pb AND ^{208}Pb NEAR THE COULOMB BARRIER. Debenham, A. A.; Griffith, J. A. R.; Irshad, M.; Roman, S. (Univ. of Birmingham, Eng.). Nucl. Phys.; A151: 81-96(1970).

Angular distributions of the vector analyzing power of the reactions ^{207}Pb(d, p)^{208}Pb(g.s.) and ^{208}Pb(d, p)^{209}Pb(0.0, 1.57, 2.03, 2.49 + 2.54 MeV) were measured at 12.3 MeV. Distorted-waves calculations were performed, yielding information on choice of the distorting potentials and the reliability of extraction of spectroscopic factors. Most features of the reactions including the polarizations can be adequately accounted for by the conventional distorted-wave theory using potentials which describe best the elastic scattering and for most of the transitions observed, the agreement is excellent. In the region dominated by Coulomb distortions the sign of polarization is simply related to the spin changes involved in the reaction. Present results indicate that the polarization is negative or positive over most of the angular range depending on whether the orbital angular momentum and spin of the captured neutron are parallel or antiparallel ($j = l \pm \frac{1}{2}$), in agreement with distorted-wave theory. (auth)

52582 HIGH-RESOLUTION SYSTEM FOR PARTICLE-GAMMA COINCIDENCE MEASUREMENTS. Amezquita, J.; Moore, C. F.; Lieb, K. P.; Kulleck, J. G.; Koike, M.; Watson,

C. E. (Univ. of Texas, Austin). Nucl. Phys.; A146: 26-32 (1970).

A high-resolution system is described for making coincidences between charged particles and γ-rays, by employing a Green-type magnetic spectrometer for the particle detection and a Ge(Li) counter for detecting the γ-rays. Using this system, branching ratios for the decays of the 3.31 MeV state in ^{90}Zr and the 3.09 MeV state in ^{92}Mo, respectively, were measured. (auth)

52583 NEUTRON SCATTERING MEASUREMENTS IN THE RESONANCE REGION. King, T. J.; Block, R. C. (Rensselaer Polytechnic Inst., Troy, N. Y.). Contract No. AT(30-3)-328. Nucl. Phys.; A138: 556-76(1969).

Neutron scattering from rhodium, cadmium, and ^{239}Pu has been measured in the energy region below 1400 eV using two ^{6}Li glass scintillators as the neutron detectors and a large-diameter liquid-scintillator detector as an anti-coincidence mantle to reduce background from capture and fission events. Spin assignments and parameter determinations have been made for seven resonances in Rh, five resonances in Cd and eight resonances in ^{239}Pu. In addition, values of the ratio Γ_n/Γ have been obtained for ten resonances in Cd from 300 to 1400 eV. Where comparisons could be made, these results are in good agreement with other experimental results. (auth)

52584 ELECTROMAGNETIC PROPERTIES OF THE FIRST 2^+ STATES OF THE EVEN Hg ISOTOPES. Kalish, Rafael (Massachusetts Inst. of Tech., Cambridge); Borchers, R. R.; Kugel, H. W. Nucl. Phys.; A147: 161-73(1970).

The excitation probabilities and the magnetic moments of the first 2^+ states of ^{198}Hg, ^{200}Hg, ^{202}Hg, and ^{204}Hg are reported. The energies of the 2^+ states and the $B(E2)_{0\to2}$ values were deduced from the γ-ray spectra observed in a Ge(Li) detector in coincidence with backscattered oxygen ions following Coulomb excitation. The g-factors of the 2^+ states were deduced from integral precession measurements following Coulomb excitation implantation into polarized iron. The results are relative to ^{198}Hg: 1.03 ± 0.10, 0.95 ± 0.11, 0.65 ± 0.08, 0.37 ± 0.04 for the $B(E2)_{0\to2}$ and 0.55 ± 0.11, 0.43 ± 0.11, 0.59 ± 0.15, 0.40 ± 0.10 for the g-factors of the 411.8 keV, 368.0 keV, 439.4 ± 0.3 keV and 436.8 ± 0.4 keV 2^+ states of ^{198}Hg, ^{200}Hg, ^{202}Hg and ^{204}Hg respectively. These results do not agree with the predictions of the theory of Kumar and Baranger, but are fairly well reproduced by the calculations of Covello and Sartoris. (auth)

52585 MESON SCATTERING AS A PROBE FOR DEFORMED NUCLEI. Jacob, M.; Kofoed-Hansen, O. (CERN, Geneva). Nucl. Phys.; B17: 565-72(1970).

Meson absorption and charge-exchange scattering on oriented, deformed nuclei should provide most valuable information on proton and neutron densities. Effects of the order of 10% or more could be obtained at presently accessible temperatures. (auth)

52586 CROSS SECTIONS FOR HIGH-ENERGY γ-TRANSITIONS FROM MeV NEUTRON CAPTURE IN ^{206}Pb. Bergqvist, I. (Research Inst. of National Defence, Stockholm); Lundberg, B.; Nilsson, L. Nucl. Phys.; A153: 553-60(1970).

Gamma-ray spectra from neutron capture in ^{206}Pb (radiogenic lead) in the energy range 1.5 to 8.5 MeV were recorded using time-of-flight techniques. The spectrometer was a NaI(Tl) crystal, 20.8 cm long and 22.6 cm in diameter. The spectra are dominated by γ-transitions to levels with large single-particle strength, in agreement with predictions of semi-direct capture theories. The theories predict enhancements of the direct capture cross section by a factor of 10 to 15 in the region of the giant dipole resonance. The observed enhancement is about 50. (auth)

52587 SHELL-MODEL CALCULATIONS IN THE LEAD REGION. Nishibori, Yutaka (Kyoto Univ.). Nucl. Phys.; A152: 641-56(1970).

Shell-model calculations are performed for five nuclei ^{210}Po, ^{210}Bi, ^{208}Bi, ^{209}Tl and ^{206}Tl, by using the K-matrices deduced from the Brueckner–Gammel–Thaler and Hamada–Johnston potentials. Then the effects of the core polarization are examined with the use of the P_2 and P_4 forces. Good results are obtained with the Hamada–Johnston potential. The effects of the P_2 and P_4 forces improve these results slightly. (auth)

52588 A MULTI-PARAMETER STUDY OF LRA FISSION AND BINARY FISSION OF ^{235}U WITH THERMAL NEUTRONS. Asghar, M. (Univ., Bordeaux); Carles, C.; Chastel, R.; Doan, T. P.; Ribrag, M.; Signarbieux, C. Nucl. Phys.; A145: 657-72 (1970).

The α-particle ternary fission (LRA) and the binary fission of ^{235}U with thermal neutrons have been studied with a multi-parametric system. The aim was to get significant results over the whole mass range including the symmetric and the far-out asymmetric regions, where the yields are low and the contamination due to the spurious events is high. A technique has been used to eliminate the spurious events. Results are presented on the energy and the mass distributions in LRA fission and binary fission. A difference of 2.6 ± 0.5 MeV is found in the mean total fission fragment kinetic energy for these two modes of fission. The α-particle probability $P_\alpha(M)$ is calculated under certain assumptions and compared with the prompt neutron $\nu(M)$ and the prompt γ-ray $N_\gamma(M)$ yield data. Results are presented on $P_\alpha(R)$. There exists an anti-correlation between $\bar{E}_\alpha$ and E_T: $\partial\bar{E}_\alpha/\partial E_T = -0.105 \pm 0.01$, and between $\bar{E}_T$ and E_α: $\partial\bar{E}_T/\partial E_\alpha = -0.45 \pm 0.06$. An effort is made to explain these various results either in a quantitative or in a qualitative way. (auth)

52589 THE $\frac{3}{2}^-[532]$ ROTATIONAL BAND IN ^{155}Gd. Kanestroem, I.; Tjoem, P. O. (Univ. of Oslo). Nucl. Phys.; A145: 461-7(1970).

A calculation including Coriolis coupling of the low-lying negative parity Nilsson model orbitals in ^{155}Gd is performed. The energy of the $\frac{3}{2}^-|532|$ bandhead is based on the Nilsson model. A comparison between the calculated and experimental energies, the (d,p) stripping and (d,t) pick-up cross sections is used to verify the suggested perturbed energy position of the $\frac{3}{2}^-|532|$ band. (auth)

52590 A COINCIDENCE STUDY OF THE DECAY OF ^{102,102m}Rh. Taylor, H. W.; Kukoc, A. H.; Singh, B. (Univ. of Toronto). Nucl. Phys.; A141: 641-52(1970).

The decay of ^{102}Rh has been investigated with Ge(Li) and NaI(Tl) spectrometers used in a coincidence arrangement. Beta-gamma coincidence measurements have been made using a plastic scintillator. Direct evidence for the β^- branching to the first excited state at 556.7 keV in ^{102}Pd has been observed. In addition to confirming most of the features of the decay scheme, the measurements have revealed a new 217 keV gamma transition and a new level at 2044 keV in ^{102}Ru. Coincidence measurements with annihilation radiation show negligible β^+ branching to the 944 and 1103 keV levels of ^{102}Ru. (auth)

52591 TRANSITION PROBABILITIES IN THE $\frac{1}{2}^+$ (631) BAND IN ^{235}U. Hoejeberg, Mats (Univ. of Stockholm); Malmskog, Sven G. Nucl. Phys.; A141: 249-56(1970).

Measurements of absolute transition probabilities in the rotational band built on the $\frac{1}{2}^+(631)$ single-particle state in ^{235}U have been performed using delayed coincidence technique. The following half-lives were obtained: $T_{\frac{1}{2}}$(13.0 keV level) = 0.50 ± 0.03 nsec; $T_{\frac{1}{2}}$(51.7 keV level) = 0.20 ± 0.02 nsec. From the deduced B(E2) and B(M1) values magnetic and electric parameters were determined which could be compared with predictions from the Nilsson model. (auth)

52592 γ-VIBRATIONAL AND GROUND-STATE ROTATIONAL-BAND MIXING IN ^{238}Pu. Palms, J. M.; Wood, R. E.; Rao, P. Venugopala (Emory Univ., Atlanta). Phys. Rev., C; 2: 1125-8(Sep 1970).

The intensities of high-energy γ rays in the 2.1-day decay of ^{238}Np to ^{238}Pu were measured using a high-resolution Ge(Li) detector (full width at half maximum of 1.7 keV at 1333 keV). The branching ratios for the transitions from the γ-vibrational band were consistent with values of $(26.5 \pm 7.8) \times 10^{-3}$ for z, the band-mixing parameter for the ground-state rotational and γ-vibrational bands, and $\approx -7 \times 10^{-3}$ for $z_{\beta\gamma}$, the parameter for the mixing of β- and γ-vibrational bands. (auth)

52593 CHARGE EXCHANGE IN ^{92}Zr(d,p)^{93}Zr. Clarkson, R. G.; Coker, W. R. (Univ. of Texas, Austin). Phys. Rev., C; 2: 1108-15(Sep 1970).

Excitation functions for the ^{92}Zr(d,p)^{93}Zr reaction to eight low-lying states in ^{93}Zr were measured from 4.2- to 11.2-MeV incident deuteron energy, a region including the (d,n) thresholds to the analogs of the observed states. Charge-exchange effects were observed for at least the $d_{\frac{5}{2}}$ ground state in ^{93}Zr. Also, ^{92}Zr(d,d) angular distributions were taken at 6.25, 7.5, and 11.0 MeV, in 5° steps from 40 to 165°, in order to obtain deuteron optical parameters. A ^{92}Zr(p,p) angular distribution was taken at 10.75-MeV proton energy in order to obtain proton optical parameters. Orbital angular momenta and estimates of spectroscopic factors were obtained for three previously unreported states in ^{93}Zr. The results of distorted-wave Born-approximation calculations for the excitation curves are discussed. (auth)

52594 EFFECTS OF CHARGE EXCHANGE IN ^{90,91}Zr(d,p). Clarkson, R. G.; Coker, W. R.; Moore, C. F. (Univ. of Texas, Austin). Phys. Rev., C; 2: 1097-1108(Sep 1970).

An extensive study of $^{90,91}Zr(d,p)$ excitation functions was carried out for deuteron energies from 5 to 11 MeV, in order to investigate the extent and systematic behavior of charge-exchange contributions to the (d,p) process. Nine residual states in ^{91}Zr, up to excitations of 3.7 MeV, were involved, as well as three residual states of ^{92}Zr, up to 1.5 MeV in excitation. In addition, deuteron elastic scattering from ^{90}Zr and ^{91}Zr was measured from 5 to 11.0 MeV, and proton elastic scattering from 9.5 to 14.0 MeV. Energy-dependent optical potentials were extracted from the elastic scattering data, and distorted-wave Born approximation analyses were performed for the (d,p) data. An effort was made to demonstrate and summarize the various factors contributing to the manifestation of the charge-exchange threshold effect in (d,p). To provide the necessary perspective, a considerable amount of other data bearing on the nature of the effect is briefly described, including possible observation of charge-exchange effects with mass-50 targets, comparison of $(p,n\vec{p})$ and $(d,n\vec{p})$ excitation curves near threshold, and resonance behavior in (p,p) and (d,p) which can confuse the experimental and theoretical situation. The experimental evidence is concluded to be consistent with the Lane model of such processes, suggested by Zaidi and von Brentano. (auth)

52595 EXPERIMENTAL STUDIES OF NEUTRON-DEFICIENT GADOLINIUM ISOTOPES. I. THE ELECTRON-CAPTURE DECAY OF ^{149}Gd. Eppley, R. E.; McHarris, Wm. C.; Kelly, W. H. (Michigan State Univ., East Lansing). Phys. Rev., C; 2: 1077-93 (Sep 1970).

Gamma rays emitted in 9.4-day ^{149}Gd were studied with Ge(Li) and NaI(Tl) detectors. Twenty-five γ rays were attributed to the decay of ^{149}Gd with energies and relative intensities of 149.6 (233), 214.5 (0.81), 252.3 (1.1), 260.5 (5.8), 272.0 (15), 298.5 (127), 346.5 (≡100), 405.5 (3.7), 430 (0.33), 459.9 (2.4), 478.7 (0.95), 496.4 (7.2), 516.4 (11), 534.2 (13), 645.2 (5.9), 663.3 (1.1), 666.2 (3.9), 748.2 (35), 788.6 (30), 812.4 (0.55), 863 (0.32), 875.8 (0.90), 933.3 (2.2), 939.1 (9.0), and 947.7 keV (3.7). On the basis of coincidence and anticoincidence experiments, relative intensities, and energy sums, states in ^{149}Eu were placed at 0, 149.6, 459.9, 496.2, 534.2, 666.0, 748.2, 794.8, 812.4, 875.8, 933.3, 939.1, and 1097.3 keV. The ^{149}Eu x-ray intensity was also measured. From γ-transition intensities and published conversion-electron intensities, conversion coefficients were obtained for most of the electromagnetic transitions, thus allowing multipolarity assignments to be made for these transitions. These assignments, together with the log ft values, were then used for the placement of limits on the spins of the deduced levels. The proposed decay scheme is compared with previously published decay schemes and is discussed in terms of current models. (auth)

52596 SPIN DETERMINATION OF RESONANCES IN $^{165}Ho(n,\gamma)$ FROM LOW-LEVEL OCCUPATION PROBABILITY RATIOS. Poenitz, W. P. (Argonne National Lab., Ill.); Tatarczuk, J. R. Nucl. Phys.; A151: 569-78(1970).

The dependence of the low-level occupation probabilities on the compound state spin has been used to assign spin values to fourteen resonances in the reaction $^{165}Ho(n,\gamma)^{166}Ho$ within the neutron energy range from 18 to 86 eV. The low-level occupation probabilities were determined from the intensities of γ-rays de-exciting these levels. These intensities have been measured in a time-of-flight experiment at the Rensselaer electron linear accelerator using a Ge(Li) detector. The spins assigned in the present experiment agree with those of the seven resonances where spin values have been recommended in BNL 325. (auth)

52597 MEASUREMENT OF NUCLEAR γ RAYS AND μ X RAYS IN MUONIC ^{209}Bi. Backe, H.; Engfer, R.; Kankeleit, E.; Schroeder, W. U.; Walter, H. K.; Wien, K. (Technische Hochschule, Darmstadt, Ger.). pp 166-8 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A Ge detector was used to measure the nuclear γ rays following muon capture in ^{209}Bi. Gamma lines corresponding to transitions from the 2.59-MeV $9/2^+$ and 2.74-MeV $15/2^+$ states were identified. Population probabilities for these states were deduced from the measured intensities. The muonic x-ray spectra were also measured in the experiment. (J.W.R.)

52598 ISOTOPIC EFFECT OF μ CAPTURE RATES IN ^{151}Eu-^{153}Eu. Backe, H.; Engfer, R.; Jahnke, U.; Kankeleit, E.; Lindenberger, K. H.; Petitjean, C.; Schroeder, W. U.; Walter, H. K.; Wien, K. (Technische Hochschule, Darmstadt, Ger.). pp 169-70 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Experimental results for muon capture rates in Eu isotopes are presented. The observed difference in capture rates between ^{151}Eu and ^{153}Eu agrees well with the predictions of the Primakoff theory. (J.W.R.)

52599 MAGNETIC HYPERFINE STRUCTURE IN MUONIC THALLIUM. Scheck, Florian (CERN, Geneva). pp 177-9 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The hyperfine splitting of the nuclear ground and first-excited states in muonic ^{203}Tl and ^{205}Tl due to the magnetic muon-nucleus coupling is discussed. The use of the configuration mixing model for explaining the experimental results is described. (J.W.R.)

52600 MEASUREMENTS OF EXCITATION PROBABILITIES AND ISOMER SHIFTS OF NUCLEAR LEVELS IN μ-ATOMS. Backe, H.; Engfer, R.; Kankeleit, E.; Schroeder, W. U.; Walter, H. K.; Wien, K. (Technische Hochschule, Darmstadt, Ger.). pp 192-4 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A compilation of results from studies on nuclear γ rays from heavy muonic atoms is presented. The studies covered excitation probabilities of nuclear levels and muonic isomer shifts in A = 169 to 205 nuclei. (J.W.R.)

52601 PARAMETERS OF THE CHARGE DISTRIBUTION OF DEFORMED NUCLEI. Hitlin, D. (Columbia Univ., New York); Bernow, S.; Devons, S.; Duerdoth, I.; Kast, J. W.; Macagno, E. R.; Rainwater, J.; Wu, C. S.; Barrett, R. C. pp 197-9 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A stable high-resolution Ge(Li) spectrometer was used to make precise measurements of the K(2p−1s) and L(3d−2p) muonic x-ray spectra of ^{150}Nd, ^{152}Sm, ^{162}Dy, ^{164}Dy, ^{166}Er, ^{170}Er, ^{182}W, ^{184}W, and ^{186}W. The data were used to determine parameters for the nuclear charge density. (J.W.R.)

52602 ISOTOPIC VARIATIONS OF THE NUCLEAR CHARGE DISTRIBUTION IN Nd. Macagno, E. R. (Columbia Univ., New York); Bernow, S.; Cheng, S. C.; (and others). pp 200-2 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Precise measurements of the energies of the muonic K and L lines in even Nd isotopes A = 142−150 were made. The data were used to determine the isotopic variation of the parameters of the nuclear charge distribution. (J.W.R.)

52603 FINITE DISTRIBUTION OF NUCLEAR M1 AND E2 MOMENTS IN MUONIC ^{115}In, ^{133}Cs, AND ^{141}Pr. Budick, B.; Lee, W. Y.; Bernow, S.; Chen, M. Y.; Cheng, S. C.; Hitlin, D.; Kast, J. W.; Macagno, E. R.; Rushton, A. M.; Wu, C. S. (New York Univ., N. Y. Columbia Univ., New York). pp 203-4 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The distribution of nuclear M1 and E2 moments in ^{115}In, ^{133}Cs, and ^{141}Pr were investigated by observing the hyperfine structure in their muonic x-ray spectra. The data are in reasonable agreement with the predictions of the configuration mixing model. (J.W.R.)

52604 RESONANCE PROCESS AND THE INTENSITY ANOMALY IN MUONIC ^{127}I. Lee, W. Y.; Bernow, S.; Chen, M. Y.; Cheng, S. C.; Hitlin, D.; Kast, J. W.; Macagno, E. R.; Rushton, A. M.; Wu, C. S. (Columbia Univ., New York). pp 205-6 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The muonic N, M, L, and K x-rays were observed and compared with a theoretical spectrum calculated within the framework of a resonance process. The resonance is between the 2p fine structure splitting and the nuclear ground and first excited states. The agreement between the observed and calculated spectrum is satisfactory. The M1 and E2 hfs constants for the 1s and 2p states were determined, and a quantitative interpretation of the observed ratios was obtained. (J.W.R.)

52605 NEW NEUTRON RICH ISOTOPES PRODUCED IN 3 BeV PROTON REACTIONS. Raisbeck, G. M.; Boerstling, P.; Riesenfeldt, P. W.; Klapisch, R.; Thomas, T. D.; Garvey, G. T. (Princeton-Pennsylvania Accelerator, Princeton, N. J. Princeton Univ., N. J.). pp 341-5 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Some preliminary data on the production of neutron rich Z = 6 to 10 isotopes in 3-GeV proton reactions on ^{197}Au are reported. (J.W.R.)

52606 FIRST RESULTS WITH A NEW CIRCULAR POLARIZATION ANALYZER ON THE PARITY MIXING IN ^{181}Ta. Diehl, H.; Hopfensitz, G.; Kankeleit, E.; Kuphal, E. (Technische Hochschule Darmstadt, Ger.). pp 722-6 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A circular polarization analyzer is described which is an improvement over previous analyzers. The analyzer was used to measure the gamma circular polarization from an unpolarized ^{181}Hf source. The measurements were used to determine the parity mixing in the ^{181}Ta 482-keV transition. (J.W.R.)

52607 CIRCULAR POLARIZATION OF γ RAYS FROM ^{181}Ta AND THE PARITY VIOLATING ONE PION EXCHANGE POTENTIAL. Vinh Mau, N.; Bruneau, A. M. (Institut de Physique Nucleaire, Orsay, France). pp 759-62 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The circular polarization of γ rays emitted in the 482-keV transition in ^{181}Ta was calculated assuming that the dominant contribution to the PNC nucleon-nucleon potential is due to one pion exchange. The unified collective model of the ^{181}Ta structure was used. The result is compared with other calculations. (J.W.R.)

52608 EXPERIMENTS ON PARITY NONCONSERVATION IN NUCLEAR GAMMA TRANSITIONS. Vanderleeden, J. C.; Boehm, F. (California Inst. of Tech., Pasadena). pp 766-70 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The circular polarization of the 482-keV transition in ^{181}Ta and the 396-keV transition in ^{175}Lu was studied using unpolarized sources of ^{181}Hf and ^{175}Yb. The results are compared with other experiments. The findings confirm the existence of a parity-nonconserving nuclear force of the magnitude predicted by CVC theory. (J.W.R.)

52609 SOURCES OF SYSTEMATIC ERRORS IN MEASURING THE CADMIUM RATIO IN ^{238}U. Bushuev, A. V.; Yurova, L. N. This paper was summarized in At. Energ. (USSR); 27: 334(Oct 1969) as paper No. 345/5155. (In Russian).

Possible sources of systematic error in measuring resonance capture in ^{238}U by means of a cadmium screen are described. Specimens were irradiated in a flux of 10^5 neutrons/cm^2-sec. Sources of error considered are the slit effect, the fuel screening effect, the effect of the cadmium "shadow," and the errors incurred in using 1/v tracers. (R.W.R.)

52610 QUADRUPOLE MOMENT OF THE ^{114}Cd NUCLEUS IN THE FIRST EXCITED STATE. Andreev, D. S.; Gusinskii, G. M.; Krokhina, K. I.; Kudoyarov, M. S.; Lemberg, I. Kh.; Chugunov, I. N. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.); 11: 247-8(20 Apr 1970).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu; 11: 369-70(20 Apr 1970).

For the first time a cyclotron was used for the determination of the value of the quadrupole moment Q_{2+} of the first excited state of ^{114}Cd. The beam consisted of singly-charged α particles and triply-charged carbon ions of 8 and 24 MeV, respectively. Spectra of the back-scattered ions were measured in coincidence with γ quanta of selected energy. Real and random peaks were fully separated. Corrections were made for target thickness, pile-up pulses, target impurities, and the Doppler shift. The result found was $Q_{2+} = -(0.53 \pm 0.17)$ b. (R.W.R.)

52611 SUBBARRIER α PARTICLES EMITTED BY NUCLEI WITH LARGE ANGULAR MOMENTA. Avdeichikov, V. V.; Lozhkin, O. V.; Perfilov, N. A. JETP Lett. (USSR) (Engl. Transl.); 11: 270-4(20 Apr 1970).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu; 11: 401-4(20 Apr 1970).

A natural Ag target was bombarded by 175.4-MeV ^{22}Ne ions, and the differential spectra of the resulting alpha particles at various angles were studied. The main parts of the α-particle spectra have a Maxwellian form with the most probable energy near a Coulomb barrier corresponding to the compound nucleus ^{130}La. The spectra could be separated into three subspectra, owing their respective forms to the dependence of the level density of the α-emitting nuclei on the excitation energy, the competition of the dipole γ radiation with the α emission, and the competition of the quadrupole γ radiation with the α emission. The latter two regions have not been observed before because of insufficient energy resolution or the small angular momenta of the compound system. The statistical model of successive evaporation of the particles with allowance for dipole and quadrupole α emission agrees well with the data. Experiments with light nuclei and with no targets have confirmed that the low-energy sections of the α spectra represent an effect of subbarrier emission of α particles. (R.W.R.)

52612 LIFETIMES OF THE EXCITED NUCLEAR STATES RESULTING FROM THE α DECAY OF ^{223}Ra AND ^{211}Bi. Komar, A. P.; Vorob'ev, A. A.; Zalite, Yu. K.; Korolev, G. A. (Ioffe Inst. of Physics and Tech., Leningrad). Dokl. Akad. Nauk SSSR; 191, 61-3(1 Mar 1970). (In Russian).

An author's earlier special microwave method was used to study the short lifetimes of heavy, α-active nuclei of the order of 10^{-10} to 10^{-12} sec. The lifetimes of 260-keV level of ^{219}Rn formed in the α decay of ^{223}Ra and the 350-keV level of ^{207}Te formed in the α decay of ^{211}Bi were determined. ^{223}Ra sources with an activity of 1 to 2 μ Cie, in equilibrium with the daughter products were used for the measurements in the first case. The half-life of the level was found to be $T_{\frac{1}{2}} = 27 \pm 3$ psec. Measurement of the lifetime of the 350-keV level of ^{207}Tl yielded a mean value of $\tau = 4.3 \pm 1.0 \times 10^{-11}$ sec. It was also found that the $\frac{3}{2}^+ \rightarrow \frac{1}{2}^+$ transition in ^{207}Tl is a single-particle transition, while similar transitions in other thallium isotopes have a phonon character. (TTT)

52613 HALF-LIVES OF TWO LONG-LIVED NUCLEAR ISOMERS, ^{108m}Ag AND ^{192m2}Ir, AND OF ^{137}Cs AND ^{204}Tl. Harbottle, Garman (Brookhaven National Lab., Upton, N. Y.). Radiochim. Acta; 13: 132-4(1970).

The first determination of the half-life of the nuclear isomer ^{108m}Ag, a much improved value for the long-lived isomer of iridium-192 (^{192m2}Ir) and check values of the relatively well-known ^{204}Tl and ^{137}Cs are reported. The data on ^{137}Cs given here are entirely new while those for ^{204}Tl represent a continuation of earlier work with the same sample. (auth)

52614 RELATIVE DELAYED NEUTRON GROUP YIELDS FROM ^{231}Pa FISSION WITH FISSION NEUTRONS. Chrysochoides, N. G.; Perricos, D. C.; Zikides, C. C. (Democritus Nuclear Research Centre, Athens). J. Nucl. Energy; 24: 157-9(Jun 1970).

Experimental procedure is briefly described. The data were computer analyzed taking into consideration only the three long-lived groups ^{87}Br, ^{137}I, and ^{88}Br. Average yields are presented together with experimental values for a three-group delayed neutron analysis from ^{235}U thermal fission. Values are compared with cumulative fission yields of the known precursors from ^{231}Pa fission. (UK)

52615 TAMM–DANCOFF CALCULATIONS ON THE ODD-MASS N = 82 ISOTONES WITH A REALISTIC INTERACTION. Freed, N.; Miles, W. (Pennsylvania State Univ., University Park). Phys. Lett.; 32B: 313-16(3 Aug 1970).

A Tamm–Dancoff calculation on the odd-mass N = 82 isotones was carried out using the realistic Elliott interaction to mix states of one- and three-quasiparticles. Single-particle energies were determined by a modified inverse-gap-equation procedure. Results are presented for energy levels, moments, transition rates, wave functions and BCS parameters for selected states. Comparison is made with experiment and with results of other calculations. (auth)

52616 UNPERTURBED ANGULAR CORRELATION FROM A LOW-DENSITY GASEOUS SOURCE. Gygax, F. N.; Jenefsky, R. F.; Leisi, H. J. (Swiss Federal Inst. of Tech., Zurich). Phys. Lett.; 32B: 359-60(3 Aug 1970).

The unperturbed γ-γ directional correlation of the 196 keV-40 keV transition in the decay ^{129m}Xe measured with a novel technique. The spin of the 236-keV level is uniquely determined to be $11/2$. (auth)

52617 INTERFERENCE OF PHOTOELECTRIC AND NUCLEAR RESONANCE ABSORPTION, AND MAGNETIC SPLITTING OF 6.25

keV γ RAYS OF ^{181}Ta. Kaindl, G.; Salomon, D. (Univ. of California, Berkeley). Phys. Lett.; 32B: 364-6(3 Aug 1970).

The interference of nuclear resonance absorption with photoelectric absorption was observed for the 6.25 keV E1 γ rays of ^{181}Ta in single-line and magnetically-split absorption spectra, in quantitative agreement with theory. From the magnetic splitting in longitudinal and transverse magnetic fields the g-factor ratio $g(^9/_2)/g(^7/_2) = 1.75 \pm 0.03$ was obtained. (auth)

52618 CHANGE OF THE NUCLEAR CHARGE RADIUS OF ^{189}Os FROM MOESSBAUER ISOMER SHIFTS. Bohn, H.; Kaindl, G.; Kucheida, D.; Wagner, F. E.; Kienle, P. (Technische Hochschule, Munich). Phys. Lett.; 32B: 346-8(3 Aug 1970).

Measurements of Mössbauer isomer shifts of the 36.2 keV and 69.6 keV γ-rays of ^{189}Os in OsO_4, $K_4Os(CN)_6$ and K_2OsCl_6 yield $\delta\langle r^2\rangle$ [36.2 keV]/$\delta\langle r^2\rangle$ [69.6 keV] = 16.6 ± 1.3, which support the notion of Coriolis-coupled rotational bands in ^{189}Os. (auth)

52619 ON THE $s_{\frac{1}{2}}^{-1}p_{\frac{1}{2}}^{-1}$) DOUBLET IN ^{206}Tl. Astner, G.; Wolf, G. K. (CERN, Geneva). Nucl. Phys.; A147: 481-7(1970).

A theoretically suggested very low-energy (less than 10 keV) state in the "two-hole" nucleus ^{206}Tl has been searched for in the decay of ^{206}Hg. A high-resolution Ge(Li) detector was used at the ISOLDE facility at CERN. No indication of such a state was found. The half-life of the 305 keV state was measured to be less than 80 psec, in contrast with earlier results. It is concluded that the $s_{\frac{1}{2}}^{-1}p_{\frac{1}{2}}^{-1}$) splitting is 305 keV. (auth)

52620 DECAY OF ^{102}Cd. Hnatowich, D. J.; Kjelberg, A.; Muennich, F. (CERN, Geneva). Nucl. Phys.; A147: 449-60 (1970).

The decay scheme of 5.5 min ^{102}Cd was investigated using isotopically separated samples produced by the ISOLDE facility. Seventeen γ-rays were observed in this decay, and they were placed in a level scheme involving ten excited states in ^{102}Ag. The ordering of the γ-rays according to established coincidence relationships has determined the energy of the 8 min (2^+) isomer in ^{102}Ag to be 9.3 ± 0.4 keV above the 13 min (5^+) ground state. (auth)

52621 DECAY OF 6.7 h ^{135}I TO LEVELS OF ^{135}Xe. Macias, E. S.; op de Beeck, J. P.; Walters, W. B. (Massachusetts Inst. of Tech, Cambridge). Contract AT(30-1)-905. Nucl. Phys.; A147: 513-26(1970).

The levels of ^{135}Xe have been investigated by studying the β- and γ-rays from 6.7 hr ^{135}I produced in thermal-neutron fission of ^{235}U. A decay scheme has been constructed consisting of 27 levels and including 63 of the 66 γ-rays attributed to 6.7 hr ^{135}I. The levels are compared with the results of nuclear reaction studies and with the levels of other odd-mass Xe isotopes. (auth)

52622 MIXING OF THE GAMMA VIBRATIONAL AND GROUND STATE BANDS IN ^{160}Dy. Keller, G. E.; Zganjar, E. F. (Louisiana State Univ., Baton Rouge). Nucl. Phys.; A147: 527-40(1970).

The γ-ray spectra accompanying the β^- decay of ^{160}Tb to levels in ^{160}Dy has been studied using Ge(Li) detectors. Coincidence measurements were made in order to separate unresolved transitions. Five reduced E2 transition probability ratios for transitions between the gamma and ground state band were computed from the measured γ-ray energies and intensities. The band mixing parameters deduced from each ratio are determined to be mutually inconsistent. The values $z_2 \times 10^3$, are: 49.5 ± 4.0, 18.7 ± 2.8, 29.2 ± 2.1, 30.5 ± 4.7, and 55.8 ± 5.6. A critical inconsistency with internal conversion data is pointed out. (auth)

52623 FOUR-PARAMETER MEASUREMENTS OF ISOMERIC TRANSITIONS IN ^{252}Cf FISSION FRAGMENTS. John, Walter; Gugy, Frank W.; Wesolowski, J. J. (California Univ., Livermore). Phys. Rev., C; 2: 1451-69(Oct 1970).

The γ rays emitted from 3 to 2000 nsec after spontaneous fission of ^{252}Cf were studied in detail. Both fission fragments were stopped on Si detectors; a Ge detector was used to detect γ rays from the fragments on one Si detector. A time-to-amplitude converter was started on the fission-fragment signal and stopped on the γ signal. For each event the two fission-fragment kinetic energies, the γ energy, and the time delay were recorded. The data were then analyzed to obtain the energy, half-life, and intensity of each γ ray as well as the mass of the emitting fission fragment. Some 144 γ rays were so analyzed, corresponding to more than 80 isomeric states. Gamma rays were observed from practically all masses. However, the intensity was concentrated in the mass regions near 96, 106, 134, and 146. The energy spectrum consisted of a group of γ rays below 500 keV and a group near 1300 keV. The high-energy group associated with masses 134 and 136 dominates the energy intensity after 50 nsec. A strong cascade from a 162-nsec isomeric state assigned to $^{134}_{52}$Te$_{82}$, and a 3000-nsec isomeric state of $^{136}_{54}$Xe$_{82}$. Rotational cascades were not observed, in contradiction with earlier low-resolution work. The observed energies and half-lives can be accounted for by E1, M1, or E2 transitions, either allowed or K forbidden by a few units. The interpretation of these results is that the initially high spins of the fragments have less effect on the delayed γ rays than was previously thought. Fragment kinetic energy distributions were obtained for fissions leading to the emission of a particular γ ray. The γ ray serves to restrict the events to those having a definite final isotope for one fragment. The average kinetic energy of such events is found to be slightly greater than the average for all fissions yielding the same mass. (auth)

52624 DOUBLE-ENERGY SINGLE-TIME-OF-FLIGHT MEASUREMENTS OF FISSION FRAGMENTS IN THERMAL-NEUTRON-INDUCED FISSION OF ^{235}U. Derengowski, Mary; Melkonian, E. (Columbia Univ., New York). Phys. Rev., C; 2: 1554-69(Oct 1970).

An experiment was performed on the thermal-neutron-induced fission of ^{235}U, in which the energies of complementary fission fragments and the time of flight of one fragment were measured. Fragment masses after neutron emission were obtained directly from this information. Pre-neutron masses and kinetic energies were deduced by means of a reflection method, which simulates a double-time-of-flight experiment. Subtraction of post-neutron from primary fragment masses then gave the number of neutrons emitted by single fragments in each event. Among the results presented are the distributions of the numbers of neutrons emitted by single fragments of fixed mass. The results also include the average number of neutrons emitted as a function of mass and total kinetic energy, as well as mass distributions in fixed kinetic energy intervals, and total kinetic distributions at fixed fragment masses. (auth)

52625 ISOBARIC ANALOG RESONANCES FROM PROTON SCATTERING ON THE BARIUM ISOTOPES. Williams, N.; Morrison, G. C.; Nolen, J. A. Jr.; Vager, Z.; von Ehrenstein, D. (Argonne National Lab., Ill.). Phys. Rev., C; 2: 1539-53 (Oct 1970).

With barium isotopes of mass 130, 132, 134, 136, and 138 as targets, proton elastic scattering excitation functions were obtained at several angles. In the proton energy range 7.0 to 12.0 MeV, several resonances were observed, which correspond to isobaric analogs of the low-lying states of the target-plus-neutron systems. The resonance data were analyzed to extract proton elastic widths, total widths, and resonance energies. Spectroscopic factors were extracted by comparing the measured proton elastic widths with the single-particle widths calculated on the basis of a shell-model description of the analog state. The spectroscopic factors so determined were compared with those from the Ba(d,p) reaction to the parent analog states. The variation of single-particle width with the parameters of the bound-state neutron well was investigated. From the analog resonance energies and the Q values for the parent states in Ba(d,p) reactions, the Coulomb shifts of the principal resonances were found. (auth)

52626 LEVEL STRUCTURE OF ^{148}Sm AND ^{150}Sm FROM AVERAGE RESONANCE NEUTRON CAPTURE. Buss, D. J.; Smither, R. K. (Argonne National Lab., Ill.). Phys. Rev., C; 2: 1513-39(Oct 1970).

The average-resonance-neutron-capture spectra of ^{147}Sm(n,γ)^{148}Sm and ^{149}Sm(n,γ)^{150}Sm obtained with the Argonne in-pile (n,γ) facility were used to develop and extend the level schemes of ^{148}Sm and ^{150}Sm. In particular, the experiment gives information about the spin and parity assignments of 33 levels with excitation energies from 0 to 2.7 MeV in ^{148}Sm and 47 levels from 0 to 2.5 MeV in ^{150}Sm. Unique spin and parity assignments are given for almost all the states below 2.2 MeV in both isotopes. In many cases in which previous experiments gave conflicting indications, the data led to definite spin assignments. The neutron binding energies in ^{148}Sm and ^{150}Sm were found to be 8140.6 ± 1.8 and 7986.4 ± 1.8 keV, respectively, after correction for the energy spectrum of the captured neutrons. (auth)

52627 NUCLEAR RESONANCE FLUORESCENCE IN ^{131}Xe. Berman, M.; Beard, G. B. (Wayne State Univ., Detroit). Phys. Rev., C; 2: 1506-13(Oct 1970).

The 637- and 723-keV states in ^{131}Xe were investigated by employing the technique of nuclear resonance fluorescence. The angular distribution of the resonantly scattered radiation from the 637-keV level was consistent with the assignment of either spin and parity $^5/_2^+$, decaying to the ground state predominantly by a M1 transition, or a spin and parity of $^7/_2^+$ with the decay to the ground state being pure E2. Considering the results of other

investigators, a $\frac{1}{2}^+$ assignment appears to be the correct choice. Assuming a spin of $\frac{1}{2}$, the mean life of the 637-keV level was found to be 1.8 ± 0.8 psec. The fact that resonant scattering from the 723-keV level was observed with a source of gaseous ^{131}II is attributed to Coulcmb fragmentation of the $(^{131}IXe)^+$ molecular ion formed following the β decay of ^{131}I. The angular distribution of the resonantly scattered 723-keV γ rays was consistent with a spin and parity assignment of $\frac{5}{2}^+$ to this level and a pure Mi decay to the ground state. Results indicate that the mean life of the 723-keV level is greater than 1.5 psec. (auth)

52628 SEARCH FOR PARITY VIOLATION IN THE GAMMA DECAY OF ^{159}Tb POLARIZED BY DILUTION REFRIGERATION. Pratt, W. P. Jr.; Schermer, R. I.; Sites, James R.; Steyert, W. A. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., C; 2: 1499-1506(Oct 1970).

A search for the parity-nonconserving contribution to the γ decay of ^{159}Tb was made. A complete description of the experimental technique is presented. The angular distribution of the 363-keV line of ^{159}Tb was measured with a pair of Ge(Li) detectors. The ^{159}Gd parent atoms were located in the +453-kG hyperfine field of $GdFe_2$ held at 28 mK by a ^{3}He–^{4}He dilution refrigerator. The resulting 7% polarization of the ^{159}Gd led to a $P_1(\cos\theta)$ term of $+(2.7 \pm 1.8) \times 10^{-4}$ in the γ angular distribution, where θ is measured with respect to the nuclear polarization. Thus, for full Tb polarization, the asymmetry would be $+(4.5 \pm 3.0) \times 10^{-3}$ $P_1(\cos\theta)$, peaked in the direction of Tb nuclear spin alignment. This sign of the $P_1(\cos\theta)$ term is based on an assumed negative moment of the ^{159}Gd parent. The magnitude of this moment was measured to be (0.22 ± 0.05) μ_N. (auth)

52629 PARTICLE-HOLE STATES IN ^{208}Pb WITH THE CONFIGURATION $(d_{\frac{3}{2}}, j^{-1})$. Kulleck, J. G. (Univ. of Texas, Austin); Richard, Patrick; Burch, D.; Moore, C. Fred; Wharton, W. R.; von Brentano, P. Phys. Rev., C; 2: 1491-9(Oct 1970).

Neutron–neutron-hole configurations of states in ^{208}Pb were studied by proton scattering through the $d_{\frac{3}{2}}$ isobaric analog resonance in ^{209}Bi. Angular distributions for the scattered protons were taken from 60 to 173° for the states in ^{208}Pb that have excitation energies between 4.69 and 6.30 MeV. The on-resonance-to-off-resonance ratio for these states was at most 15:1. The resolution in all spectra was 18 keV or better. The data were analyzed to obtain total proton inelastic scattering cross sections. With this information and the proton single-particle widths extracted from elastic scattering data, total inelastic proton partial widths were calculated. Final-state spins were specified by fitting the observed angular distributions with an appropriate expression for the differential cross section and by comparing those results to information derived from other experiments. (auth)

52630 MEASUREMENTS OF STATIC QUADRUPOLE MOMENT OF THE FIRST EXCITED 2^+ STATES OF THE NUCLEI ^{106}Pd AND ^{110}Pd BY HEAVY-ION COULOMB EXCITATION. Beyer, R.; Scharenberg, R. P.; Thomson, J. (Purdue Univ., Lafayette, Ind.). Phys. Rev., C; 2: 1469-79(Oct 1970).

The static quadrupole moments of the 511.7-keV 2^+ state in ^{106}Pd and the 373.8-keV 2^+ state in ^{110}Pd were determined by employing Coulomb-excitation techniques. Foils (~175 $\mu g/cm^2$) of separated Pd isotopes were bombarded with 25- and 30-MeV ^{16}O ions and 55- and 56-MeV ^{32}S ions from the Purdue University and Argonne National Laboratory tandem accelerators. The angular distributions of the inelastically scattered ions were measured in coincidence with the deexcitation γ rays to determine the relative excitation probabilities. The experimental data were fitted using the Winther–de Boer multipole-Coulomb-excitation program so that the sign and magnitude of the static quadrupole moment could be extracted. The effect of higher excited states on the excitation probability of the 2^+ state was calculated using the matrix elements determined by Robinson et al. and the Winther–de Boer program. Self-consistency of the oxygen and sulfur data suggests that the excitation via the second 2^+ state interferes constructively so as to increase the excitation probability. With this choice for the interference via the second 2^+ state, the values of the static quadrupole moments are $Q_{22} = -0.458 \pm 0.059$ b for ^{106}Pd and $Q_{22} = -0.483 \pm 0.049$ b for ^{110}Pd. If the excitation via the second 2^+ state interferes destructively, the values of the static quadrupole moments are $Q_{22} = -0.282 \pm 0.059$ b for ^{106}Pd and $Q_{22} = -0.266 \pm 0.049$ b for ^{110}Pd. (auth)

52631 ISOMERIC TRANSITIONS IN 29-DAY ^{179m_2}Hf. Huebel, H. (Princeton Univ., N. J.); Naumann, R. A.; Hopke, P. K. Phys. Rev., C; 2: 1447-51(Oct 1970).

The 29-day isomer ^{179m_2}Hf was found to decay via 21.03- and 257.32-keV transitions to the $\frac{21}{2}^+$ and $\frac{19}{2}^+$ members of the ground-state rotational band of ^{179}Hf. From conversion-electron studies, M2 and E3 multipolarities were deduced, respectively, for the 21.03- and 257.32-keV isomeric transitions. The spin and parity $\frac{25}{2}^-$ was assigned to the isomeric state. (auth)

52632 NUCLEAR DATA. Baker, P. S. (Oak Ridge National Lab., Tenn.). pp 1-63 of Handbook of Radioactive Nuclides. /Wang, Yen (ed.). Cleveland; Chemical Rubber Company (1969).

The decay characteristics of radioisotopes are briefly discussed. The methods for radioisotope production and processing are surveyed. Tables are presented which give physical and chemical characteristics of radioisotopes with reasonable expectancy of routine production. Other tables are presented which contain the properties of elements and their commercially available isotopes. (J.W.R.)

52633 NUMBER-CONSERVING CALCULATION OF THE LOW-ENERGY SPECTRA OF THE ODD–ODD Tl ISOTOPES. Fubini, A. (Laboratorio di Fisica Nuclear Applicata, Casaccia, Italy); Lo Iudice, N.; Prosperi, D.; Salusti, E. Nuovo Cim.; 68A: 502-12(1 Aug 1970).

A calculation is reported of the low-energy spectra of odd-odd Tl isotopes. The method applied is a simplified version of a theory first suggested to treat pairing correlations in nuclei without violating particle number conservation. The nn and pp interactions are schematized by pairing Hamiltonians. The np interaction is a contact force having a J-dependent amplitude which, as shown by Pandharipande, schematizes a force containing both central and tensorial components. The results obtained are in satisfactory agreement with experimental results for all isotopes. (auth)

52634 STATISTICAL ANALYSIS OF NEUTRON RESONANCE PARAMETERS AND σ_f FOR ^{235}U. Bochvarov, S.; Dermendzhiev, E.; Kashukeev, N. (Joint Inst. for Nuclear Research, Dubna, USSR). Compt. Rend. Acad. Bulg. Sci.; 23: 141-4(1970). (In Russian).

A statistical analysis of neutron resonance parameters for several spin groups in ^{235}U which have been previously determined was performed. The fission cross section of ^{235}U in the energy range E_n = 0.3 to 2000 eV was also analyzed by the statistical method. (R.V.J.)

52635 SPECTRA OF LOWER LEVELS OF ^{111,113}Cd, ^{123,125}Te, AND ^{127,129}Xe. Belousova, V. I. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 1, 124-5 (1969). (In Russian).

The core-particle model was used for calculating the lower level spectra of ^{111,113}Cd, ^{123,125}Te, ^{127,129}Xe nuclei. Theoretical results were in good agreement with the experimental data. (R.V.J.)

52636 SEPARATION OF DIRECT-REACTION AND COMPOUND-NUCLEUS CONTRIBUTIONS TO (p,p') REACTIONS IN Sn ISOTOPES. Cohen, B. L.; Rao, G. R.; Fink, C. L.; Van der Weerd, J. C.; Penkrot, J. A. (Univ. of Pittsburgh). Phys. Rev. Lett.; 25: 306-9(3 Aug 1970).

By comparing energy spectra of protons from (p,p') reactions on various tin isotopes, a clean separation between direct-reaction and compound-nucleus contributions is made and the two processes are studied independently. The compound-nucleus results are in good agreement with predictions from the Gilbert–Cameron level densities. The direct-reaction angular distributions become quite isotropic for large –Q; the direct reaction cross section at 17 MeV is about one-third of the total reaction cross section. (auth)

52637 UNEXPECTED STRONG PAIR CORRELATIONS IN EXCITED 0^+ STATES OF ACTINIDE NUCLEI. Maher, J. V.; Erskine, J. R.; Friedman, A. M.; Schiffer, J. P.; Siemssen, R. H. (Argonne National Lab., Ill.). Phys. Rev. Lett.; 25: 302-6 (3 Aug 1970).

The (p,t) reaction was studied with 17-MeV protons on targets of ^{230}Th, ^{234,236,238}U, and ^{242,244}Pu. The results indicate unexpectedly strong l = 0 transitions to states at about 900-keV excitation. Their cross sections are approximately 15% of the ground-state transitions; this percentage does not change appreciably with neutron number. This result, together with other available evidence, seems to suggest a simple and rather stable collective mode which has not yet emerged from any theoretical calculations. (auth)

52638 STRUCTURE IN THE RESONANCE NEUTRON CAPTURE IN ^{115}In. Coceva, C.; Corvi, F.; Giacobbe, P.; Stefanon, M. (EURATOM, Geel, Belgium. Comitato Nazionale per l'Energia Nucleare, Bologna). Phys. Rev. Lett.; 25: 1047-9 (12 Oct 1970).

Gamma rays from resonance neutron capture in ^{115}In were detected in the neutron energy range 40 eV–1 keV. The resonance

energy dependence of the radiative transition intensities to the low-lying levels shows a nonstatistical structure. This structure is found to be correlated with the local neutron strength function. (auth)

52639 DETERMINATION OF THE SPIN AND THE RESONANCE PARAMETERS FOR ^{107,109}Ag +n, ^{169}Tm +n, Pt +n FROM 4 eV TO 830 eV. de Barros, S. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro); Huynh, V. D.; Julien, J.; Morgenstern, J.; Samour, C. Notas Fis., Cent. Brasil. Pesqui. Fis.; 15: 167-241 (1969). (In French).

Experiments on silver, thulium and platinum have been performed with the Saclay linear accelerator using the time-of-flight method. Resonance parameters are given for resonances detected in the 4 to 830 eV energy range and the spin value is assigned to most of the levels. The strength function dependence against neutron energy and spin value (J = 1 or 0) is discussed for these target nuclei with I = ½. The distribution of neutron reduced widths and of level spacings is given and the results are discussed. A variation of the total radiative width $\overline{\Gamma_\gamma}$ is found for ^{195}Pt + n for each spin state. This effect is interpreted from the intensity of transitions to the ground state and the first excited states. (auth)

Nuclear Theory

Refer also to abstracts 51983, 51993, 52019, 52114, 52117, 52121, 52123, 52126, 52135, 52172, 52520, 52541, 52544, 52566, 52585, and 52587.

52640 (AI-AEC-12931) UNIFIED MODEL FOR ANALYSIS OF COMPOUND NUCLEUS REACTIONS. Dunford, C. L. (Atomics International, Canoga Park, Calif.). 15 Jul 1970. Contract AT(04-3)-701. 28p. Dep. CFSTI.

The analysis of fast neutron cross sections are hampered by a lack of a unified model for calculations. This document presents a unified model of compound nucleus reactions which will allow a consistent calculation of compound nucleus reactions of interest to the cross section evaluator. The remaining direct reaction cross sections may be calculated by an optical model code which also provides the necessary input compound nucleus formation probabilities for the reaction cross section calculations. The results are useful for understanding the energy behavior of fast neutron cross sections and as an aid to the production of evaluated cross-section data in regions where no experimental data exist. (auth)

52641 (CEA-CONF-1568) STUDY OF A LOCAL AND NON-SINGULAR NUCLEON-NUCLEON FORCE IN THE FRAMEWORK OF THE HARTREE-FOCK THEORIES. Gogny, D.; Pires, P. (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). 1970. 29p. (In French). Dep. CFSTI (U. S. Sales Only).

Among the potentials that can reproduce the data of the two body problem one potential was sought, which when used in conjunction with the Hartree-Fock theory would reproduce some of the properties of finite nuclei. The general plan of studies was: the nucleon-nucleon interaction, the study of the two body problem, the Hartree-Fock theory (formalism, symmetry and choice of a representation, practical methods), nuclear matter, and the testing of the nucleon-nucleon interaction. The results concerning a particular potential are presented and discussed. (auth) (France)

52642 (CEA-N-1285) AVERAGE ENERGY EMITTED BY UNSTABLE β^- NUCLIDES. Barre, Bertrand; de Tourreil, Roland (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Apr 1970. 36p. (In French). Dep. CFSTI (U. S. Sales Only).

A code for calculating the average energy of an allowed β^- transition, or the average energy of an allowed β^- disintegration spectrum is described. Two versions of this code are given: a UNIVAC 1108 version and an IBM 360. The energy spectrum of a β^- transition is integrated from a tabulation of the Fermi functions; the energy emitted as γ radiation is obtained by difference. (auth) (France)

52643 (CEA-N-1308) PROGRAM FOR CALCULATION OF FISSION-PRODUCT ACTIVITY: CALCULATED ACTIVITY AND EXPERIMENTAL IDENTIFICATION. Le Meur, R.; Poux, C. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 8 Apr 1970. 63p. (In French). Dep. CFSTI (U. S. Sales Only).

The fission product activity was calculated by the program according to experimental conditions (irradiation, decrease, collection). The intensity of radiations (γ, β and conversion electrons) emitted by the fission products was also determined. The program is compatible with C.D.C. and I.B.M. and is recorded on the MAJONG disc. The structure of the program and the application of the subprograms are presented. An example of calculation is given and the listing of the program appears in the appendix. (auth) (France)

52644 (ISS-69/34) ON THE POSSIBILITY OF STUDYING THE DIFFERENCE BETWEEN PROTON AND NEUTRON DISTRIBUTIONS IN NUCLEI BY QUASI-FREE SCATTERING REACTIONS. Kabachnick, N. M. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 8 Sep 1969. 12p. Dep. CFSTI (U. S. Sales Only).

The possibility of studying the difference between proton and neutron distributions in nuclei by means of (e,e'p) and (e,e'n) reactions is analyzed. The difference in the momentum distributions thus obtained can be related to the difference in radii of the proton and neutron distributions through the uncertainty principle. For $A \leq 40$, this difference is probably beyond present experimental techniques. For heavier nuclei, there is certainly a difference in the momentum distributions of protons and neutron since they fill different shells. This leads to different forms of the momentum distributions, even with the same radii for the two potential wells. A reasonable difference in the radii of these wells has the effect of changing the momentum distributions by the same order of magnitude as the difference due to the filling of different shells. Therefore, from the existence of an experimental difference in the momentum distributions, it will be very hard to conclude that protons and neutrons fill wells of different radii. To decide this one must use some model; thus, the result becomes strongly model-dependent. (R.W.R.)

52645 (JINR-P4-5126) SINGLE-PHONON STATES OF EVEN-EVEN NUCLEI IN THE ACTINIDE REGION. Komov, A. L.; Malov, L. A.; Solov'ev, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1970. 19p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The properties of the lowest even-even nucleus states of the actinide region are investigated systematically within the framework of the superfluid model with the multipole-multipole interaction in a single-phonon approximation. The energies and transition probabilities for Eλ-transitions are calculated, and the structure of quadrupole $K^\pi = 0^+$, 2^+ and octupole $K^\pi = 0^-$, 1^-, 2^-, 3^- states is analyzed. The Saxon-Woods potential states and those of the Nilsson potential are used as a single-particle basis. (auth)

52646 (LYCEN-7036) MECHANISM OF THE $(\alpha,2\alpha)$ BREAK UP REACTION IN A THREE BODY FORMULATION. Burdet, G.; Perrin, M. (Lyon Univ. (France). Institut de Physique Nucleaire). May 1970. 6p. Dep. CFSTI (U. S. Sales Only).

The mechanism of the $(\alpha,2\alpha)$ breakup reaction was studied in the framework of the three-body problem. The process was postulated to be based on the interaction through the two-body potentials of a bombarding alpha particle with a compound target consisting of two particles: the core and an alpha cluster. (France)

52647 (NP-18407) FISSION CHARACTERISTICS OF TRANSURANIUM ELEMENTS. Lefort, Marc (Paris Univ., Orsay (France). Institut de Physique Nucleaire). Apr 1970. 19p. (In French). Dep. CFSTI (U. S. Sales Only).

Attempts were made to predict the fission characteristics of transuranium elements. The evolution of the configurations of the liquid-drop model as a function of fission parameters was reviewed in detail, and the superposition of a microscopic model on the liquid-drop model was considered; in particular, the Nilsson microscopic model was applied to the study of nuclear deformations. Considerable theoretical progress was made on this problem; new phenomena concerning fission isomers could be predicted and related to resonances found below the threshold of neutron-induced fissions. However, the mechanisms involved remain obscure and most of the predictions are tentative. (auth) (France)

52648 (ORNL-4591) TABLE OF MAGNETIC HYPERFINE-STRUCTURE ANOMALIES. Fuller, G. H.; Cohen, V. W. (Oak Ridge National Lab., Tenn.). Sep 1970. Contract W-7405-eng-26. 27p. Dep. CFSTI.

A table of magnetic hyperfine-structure anomalies calculated from measured moment ratios is presented. The measured nuclear g ratios and ratios of both magnetic and electric hyperfine interaction constants are included. References to the original papers are given for the ratios listed, along with a code letter which indicates the experimental methods used. The cut-

off date for the literature search is December 1969. (149 entries) (auth)

52649 (TID-25504) REALISTIC INTERACTIONS AND EXCHANGE EFFECTS IN MICROSCOPIC DESCRIPTIONS OF ELASTIC AND INELASTIC NUCLEON SCATTERING. Owen, Larry Wayne (Tennessee Univ., Knoxville). Aug 1970. 145p. Dep. CFSTI.

Thesis.

The effects of exchange in microscopic descriptions of elastic and inelastic nucleon-nucleus scattering using realistic nucleon–nucleon effective interactions were investigated. The interaction in even states of relative motion is taken to be the long-range part of the Hamada–Johnston potential. Possible effects upon the elastic scattering of a central interaction in singlet-odd states are investigated. The spin-orbit optical potential is calculated using two estimates for the nucleon–nucleon spin-orbit interaction in triplet-odd states. The microscopic model of the real part of the optical potential consists of a direct term which is local, and an exchange term which is nonlocal and different for each partial wave. The ground state wave functions of the target nuclei are assumed to be given by the independent particle model. Oscillator, Woods–Saxon, and Hartree–Fock single-particle functions are used. The scattering induced by these nonlocal potentials is obtained exactly by explicitly solving the integro-differential Schroedinger equations. In addition, equivalent local potentials of the Woods–Saxon form are obtained by fitting the scattering from the microscopic potentials. The dependence of the equivalent local potentials upon energy, neutron excess and $Z/A^{\frac{1}{3}}$ is investigated. The "Perey effect" for nonlocal potentials is observed. Many important features of phenomenological optical potentials are reproduced with this microscopic model to a surprising degree of accuracy. Exchange effects in the inelastic scattering of protons with the Hamada–Johnston interaction are found to be very important. However, the contributions from interaction with the valence nucleons in nuclei with simple configurations are much smaller than the observed cross sections. Core polarization effects, estimated with a collective model description of the core, are very strong. (auth)

52650 (UCRL-19529) THE THEORETICAL ANALYSIS OF NUCLEAR REACTIONS INVOLVING STRONGLY DEFORMED NUCLEI USING PHENOMENOLOGICAL MODELS. Mackintosh, Raymond Stuart (California Univ., Berkeley. Lawrence Radiation Lab.). Mar 1970. Contract W-7405-eng-48. 259p. Dep. CFSTI.

Thesis.

Stripping reactions, A(d,p) A + 1, are studied for the case where A is a strongly deformed nucleus. In the standard treatment, using DWBA, the possibility that the projectiles d and p can set the nucleus in rotational motion is ignored. We have studied in detail the importance of these inelastic processes using the coupled-channel source-term technique of Ascuitto and Glendenning. We have shown this to be equivalent to the coupled-channel Born Approximation written down by Penny and Satchler. We have also generalized a formal derivation of DWBA given by Greider and Dodd. We have discovered that for A ~ 25 and for 10- and 12-MeV deuterons, inelastic processes are of vital importance—that relative strengths of levels may be greatly changed by their inclusion and that angular distributions may be significantly improved, although the detailed shape is still not reproduced for these light nuclei. This latter failing, therefore, seems to be characteristic of any generalization for zero-range DWBA to include rotational excitations. For 12-MeV deuterons in the deformed rare earth region, the inclusion of inelastic processes will, in general, lead to substantial differences in values, extracted by comparison with experiment, of the amplitudes with which particular angular momenta occur in the various Nilsson states. Angular distributions of weaker levels in a band are often changed substantially and the change in stripping strengths of various levels is quite comparable to that which is a result of Coriolis mixing (not included in our calculations). Our calculations involve purely macroscopic rotational excitations, and we further ignore transitions between members of different bands of the odd-A residual nucleus. (auth)

52651 SOLUTION OF A THREE-BODY PROBLEM IN A SIX-DIMENSIONAL ISOTROPIC HARMONIC OSCILLATOR BASIS. Erens, G.; Visschers, J. L.; van Wageningen, R. (Univ. of Amsterdam). pp 291-300 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

Consideration is given to a system of three identical spinless bosons interacting through local two-body potentials. In this case the ground state wave function is symmetric under particle permutations and has zero total angular momentum. After separating out the center-of-mass motion a problem in a six-dimensional configuration space remains, and transformation to a complete orthonormal set of basis functions in this space gives a matrix eigenvalue problem that can be solved to give the ground state energy and wave function. The eigenfunctions of a six-dimensional isotopic harmonic oscillator in hyperspherical coordinates in chosen as basis. Two types of harmonics are used; firstly those of Simonov (Soc. J: Nucl. Phys. 3: 461, 755 (1966)), which have convenient transformation properties under particle permutations, and secondly the Zerike-Porenkman polynomials (Proc. Con. Acad. Wetensch 33: 3(1935)), which form a suitable set for the case where only two of the particles are identical, and that can also be used for the case of three identical spinless bosons if only one angular momentum-isospin state is taken into account. 7 references. (UK)

52652 FINAL STATE INTERACTIONS AND QUASI-FREE SCATTERING. Slaus, Ivo (Inst. Rudjer Boskovic, Zagreb). pp 337-89 of Three Body Problem in Nuclear and Particle Physics. /McKee, J. S. C. (ed.). Amsterdam; North-Holland Publishing Co. (1970).

From International Conference on the Three-Body Problem, Birmingham, England. See CONF-690710.

It is stated that the study of processes leading to three or more particles in the final state gives information on (1) the dynamics of few-body systems, (2) the interaction between two particles on and off the energy shell, (3) spectroscopic data-energies, widths, and other parameters, (4) and possibly quantitative conclusions about many-body forces. Reactions involving light nuclei often lead to multi-particle final states. Processes are discussed emphasizing particular two-body interactions in a multi-particle reaction, and if properly understood these may give information on two-body forces. The quasi-free process and the final state interaction model are considered, and diagrams for an infinite series of rescattering corrections are shown; the effect of rescattering is small. The quasi-free scattering can be modified by the final state interaction. The multi-particle reaction can proceed as a simultaneous break-up, and the matrix element may be independent of momentum transfer variables. The distribution of events is then given by the available phase space. Various simple processes, such as final state interactions and simultaneous break-up, can interfere. Questions discussed include (1) how accurately do the models describe the final state interaction and quasi-free processes; (2) how important are higher order corrections; (3) the energy dependence of FSI and QF processes; (4) the adequacy of knowledge of reaction mechanisms; (5) can these processes be used to extract reliable particle-particle interaction information and reliable spectroscopic information; (6) quantitative estimates of the simultaneous break-up contribution; (7) are multi-particle reactions influenced by three-particle final state interactions; and (8) are there any data to be involved other than two-body interactions. Main headings are as follows: final state interactions; possible excited states of the three-nucleon system; quasi-free processes; and experimental techniques and trends. 171 references. (UK)

52653 INVESTIGATIONS OF SHORT-RANGE CORRELATIONS BY MEANS OF ELECTRON SCATTERING FROM NUCLEI. Maleckl, A. (Inst. of Nuclear Physics, Krakow); Picchi, P. Riv. Nuovo Cim.; 2: 119-46(Jan-Mar 1970).

Several possible electron-beam experiments by which the short-range structure of nuclear interactions can be studied are considered. Various methods of introducing the short-range correlations into the nuclear wave function are discussed, including the perturbation approach, the model-wave-function method, and velocity-dependent potentials. Calculations regarding the implications of correlations on elastic and inelastic electron scattering are reviewed. It is shown that correlations lead to an additional structure of the elastic cross section and to a central depression of the nuclear charge density. (R.W.R.)

52654 HEAVY-ION ELASTIC SCATTERING AND TRANSFER REACTIONS. Anni, R. (Univ., Lecce, Italy); Taffara, L. Riv. Nuovo Cim.; 2: 1-101(Jan-Mar 1970).

Elastic scattering and transfer reactions initiated by heavy ions are reviewed. Analysis of elastic scattering by the diffraction scattering method and the optical-model method is discussed, and some disadvantages of the latter are pointed out. Transfer reactions are considered with respect to the DWBA, the T-matrix approximation, and the Feynman-diagram summation method. The DWBA theory is discussed at some length. Transfer reactions both above and below the Coulomb barrier are examined. (137 references.) (R.W.R.)

52655 CRITICAL TEST OF STATISTICAL THEORY OF NUCLEAR FISSION. Fong, Peter; Ertel, John P. Jr. (Emory Univ., Atlanta). Bull. Ga. Acad. Sci.; 28: 73-9(Jan 1970).

The classical three-body problem of the two fission fragments and the long-range α-particle in ternary fission is solved numerically by computer. The statistical theory of nuclear fission developed previously provides a complete specification of the initial conditions which determine the particular solution of the three-body problem. The angular correlation of the particles so determined is sensitively dependent on the initial conditions and thus provides a critical test of the statistical theory. The theoretical results obtained are in good agreement with the experimental results. (R.W.R.)

52656 MECHANISM OF THE $(\alpha,2\alpha)$ BREAK-UP REACTION IN A THREE-BODY FORMULATION. Burdet, G.; Perrin, M. (Univ., Lyon). Lett. Nuovo Cim.; 3: 762-6(13 Jun 1970).

The mechanism of the $(\alpha,2\alpha)$ breakup reaction in the framework of the three-body problem is investigated. It is assumed that the process is based on the interaction through two-body potentials of a bombarding α particle with a target compounded of two particles, the core plus an α cluster. The mechanisms which must be taken into account for a general three-body approach to breakup reactions are shown, as well as the method of obtaining the transition amplitude as an integral equation whose inhomogeneous term gives a support to the Feynman diagram summation. (R.W.R.)

52657 ANTIANALOGS AND GAMMA DECAY OF ANALOG STATES. Birbrair, B. L. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR)(Engl. Transl.); 11: 38-41(5 Jan 1970).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu; 11: 60-4(5 Jan 1970).

It is shown that analog–antianalog gamma transitions can serve as a source of unique information concerning the structure of nuclear states. Although the "parent" state and the analog and antianalog corresponding to it are not purely single-particle states, they may be so assumed with accuracy of order 1/(N-Z). Study of the structure of nuclear states by analog-antianalog gamma transitions instead of nuclear reactions has the advantage that uncertainty connected with the assumptions concerning the mechanism of the reaction does not enter consideration. (R.W.R.)

52658 COMPRESSIONAL-MODE OSCILLATIONS IN A NUCLEUS. Onley, D. S. (Ohio Univ., Athens). Nucl. Phys.; A149: 197-208(1970).

Investigation is made of the possibility of a dwarf dipole resonance ($\Delta J^{\pi} = 1^{-}$, $\Delta T = 0$) due to oscillation of nuclear matter in a compressional fashion, analogous to the giant dipole resonance which is an oscillation in the polarization of nuclear matter. A Lagrangian density is introduced to describe the propagation of sound waves in a medium of non-uniform density, along with a constraint to eliminate spurious c.m. motion. The frequencies of the normal modes of oscillation are calculated for a droplet which has an equilibrium density distribution compatible with that determined from elastic electron scattering; the velocity of sound is an adjustable parameter. Coulomb form factors for excitation of levels at 10.8 MeV in ^{12}C, and 7.12 MeV in ^{16}O (which have suitable quantum numbers for the resonance) are compared with inelastic electron scattering experiments. Agreement is found for the shape of the differential cross section, the calculated magnitude is generally too large by a factor which varies from 2 to 50 depending on the behavior assumed for the density in the neighborhood of the nuclear surface. The interpretation of these levels as compressible modes is therefore tentative; the velocity of sound required is about 0.04 c. (auth)

52659 MICROSCOPIC DESCRIPTION OF NUCLEAR VIBRATIONS WHEN PHONONS OCCUR AT RELATIVELY LOW ENERGY. I. THEORY. Neergard, K. (Univ. of Copenhagen); Vogel, P. Nucl. Phys.; A149: 209-16(1970).

The corrections to the random-phase approximation due to particle–phonon interactions are evaluated to lowest order, and equations suitable for practical calculations are obtained. (auth)

52660 OFF-ENERGY-SHELL BEHAVIOUR OF A CLASS OF PHASE EQUIVALENT SEPARABLE AND LOCAL POTENTIALS. Srivastava, M. K.; Sprung, Donald W. L. (McMaster Univ., Hamilton, Ont.). Nucl. Phys.; A149: 113-40(1970).

Local potentials which have the same S-matrix as the separable potentials of Mongan and Tabakin in the $^1S_0$ case have been constructed. The method used is general, but the explicit solution given here applies whenever the S-matrix is of rational form. The off-shell behavior of pairs of on-shell equivalent potentials is investigated. Close agreement is found to hold only at sufficiently low energies. The separable approximation of Noyes is studied and found to be valid over specified ranges of the energy-momentum variables. The effective range formula has been extended to the off-shell case. (auth)

52661 PAIRING FORCE IN THE QUASI-BOSON APPROXIMATION. Johns, Oliver (Univ. of Copenhagen). Nucl. Phys.; A154: 65-92(1970).

A modified form of the BCS + RPA method for 0^+ states is presented which changes the zero-frequency boson and the effective Hamiltonian. The modified theory is closely related to the Nogami method. Complete BCS + RPA state vectors are calculated and displayed graphically for a model system of two $j = 9/2$ levels, illustrating the improvements produced by the modified theory. (auth)

52662 DISPERSION RELATION APPROACH TO THE NUCLEAR STRUCTURE CALCULATION. Razavy, M.; Hodgson, R. J. W. (Univ. of Alberta, Edmonton). Nucl. Phys.; A149: 65-85(1970).

Partial-wave dispersion relations are used as dynamical equations describing nucleon–nucleon scattering. For each state, from the empirical values of the phase shifts for different relative energies of the two nucleons, the first term of the Born series is obtained. In this connection, approximate methods of solving the inverse of a dispersion relation are discussed, and the results are compared with those obtained from the Schrödinger equation. Off-diagonal elements of the Born term for energy non-conserving processes are found by extrapolating the diagonal elements. The matrix obtained in this way enables one to calculate the reaction matrix and also the harmonic oscillator matrix elements directly from the phase shifts. Numerical results for both types of calculation are presented and compared with recent works of Elliott and collaborators. (auth)

52663 TIME DEPENDENCE OF PARTICLE CORRELATIONS IN MUON CAPTURE. Bukhvostov, A. P.; Popov, N. P. (Ioffe Inst. of Physics and Tech., Leningrad). Nucl. Phys.; A147: 385-400(1970).

The formulae for the correlations between the directions of the neutrino and gamma-ray momenta and the vector of muon polarization are obtained for muon capture with the excitation of a daughter nucleus. Time dependence of the particle correlations, which is caused by the conversion between the hyperfine K-shell sublevels, is analysed. Gamma-neutrino angular correlation is discussed in detail for muon capture by the ^{14}N nucleus. (auth)

52664 THEORY OF ROTATION OF STRONGLY DEFORMED NUCLEI. Krutov, V. A.; Zackrevskii, N. V.; Saprykin, B. I. (Leningrad State Univ.). Ann. Phys. (Leipzig); 23: 1-9(Jun 1969). (In German).

The calculations of the moments of inertia of the strongly deformed even-even nuclei in the regions $22 \leq A \leq 32$, $150 \leq A \leq 186$, $224 \leq A$ have been carried out. The results are in agreement with the experimental data. The nonaxiality of the nuclear equilibrium shape has been taken into account. Calculations of the moments of inertia in the case of the nonhomogeneous (trapezoidal) nuclear density distribution have been carried out as well. The formulae for deriving the parameters of deformation of mass and potential from the position of the rotational levels are represented, the calculations of these parameters being carried out for the nuclei of the above mentioned regions. The results of the calculations have been compared with those received from the quadrupole moments and with the deformation of the nuclear potential, received from the inelastic scattering data. (auth)

52665 α-PARTICLE TRAJECTORIES IN TERNARY FISSION. Fong, Peter (Emory Univ., Atlanta). Phys. Rev., C; 2: 735-42 (Aug 1970).

The trajectories of the α particle and the two main fragments produced in ternary fission are calculated by computer on the basis of initial conditions determined by the statistical theory of fission. The angular and energy distributions of the three particles as functions of the mass ratio of the main fragments are deduced; they compare well with the experimental results of Fraenkel on spontaneous fission of ^{252}Cf. Calculations are repeated with varied initial conditions; the final results are insensitive to the initial velocities of the fragments and the initial position of the α particle, but are very sensitive to the initial velocity of the α particle. Based on this sensitivity, the experimental angular distribution strongly supports the view of the statistical theory that the fission process is a slow process. The initial positions of the fragments are related to the prompt-neutron distribution; the present results on angular

and energy distributions are consistent with experimental results of prompt-neutron distribution. (auth)

52666 EFFECTIVE OPERATORS IN THE NUCLEAR SHELL MODEL. I. GENERAL THEORY. Harvey, M.; Khanna, F. C. (Chalk River Nuclear Labs., Ont.). Nucl. Phys.; A152: 588-608(1970).

A general formalism for defining an effective operator $\tilde{t}$ in a truncated Hilbert space is presented and is shown to depend on the operator ν_{21} which connects the included and the excluded Hilbert space. The projection operator technique is used. The usual method of calculating the effective interaction in a restricted Hilbert space is a special case of this formalism. Details for an effective electromagnetic transition operator are given and it is shown that the effective electromagnetic operator has one-, two-, three- and four-body parts if the usual assumption that ν_{21} is a two-body operator is made. Connection of the present formulation with some earlier calculation of the effective charge for E2 transitions is discussed. (auth)

52667 NUCLEAR SURFACE PROPERTIES WITH A SIMPLE EFFECTIVE INTERACTION. Moszkowski, Steven A. (Univ. of California, Los Angeles). Phys. Rev., C; 2: 402-14(Aug 1970).

A simple three-part density-dependent effective interaction is used to calculate several general properties of the semi-infinite nuclear surface. This interaction, which is referred to here as the modified δ interaction (MDI), is quite similar to one introduced by Skyrme. The three parameters of the MDI are fixed by fitting the binding energy and density of infinite nuclear matter with N = Z and also the ground-state energy of ^{16}O, all in first-order perturbation theory. The nuclear surface properties are calculated in several different ways. First, they are extracted directly from the single-particle wave functions of a one-dimensional static Woods–Saxon potential. The diffuseness and depth of the potential are obtained by minimizing the surface energy. This procedure is called the independent particle model (IPM). The resulting surface thickness of 2.2 fm and surface energy of 19.3 MeV and the approximately Fermi shape of the density distribution are in good agreement with empirical results. The calculations were then repeated using the Thomas–Fermi approximation to obtain the density. The resultant surface thickness and surface energy, 2.0 fm and 16.0 MeV, are considerably smaller than the IPM results. Furthermore, the calculated density distribution has a longer "shoulder" inside the nucleus and a shorter "tail" outside than the IPM distribution. (auth)

52668 HOW DO DEFORMED NUCLEI ROTATE? Rowe, D. J. (Univ. of Toronto). Nucl. Phys.; A152: 273-94(1970).

The character of the rotational motion implied by the highly successful adiabatic rotational model is examined with the objective of determining the ground rules for a microscopic rotational theory based on this model. It is deduced that the adiabatic model implies rotational flow, i.e., rigid-body flow except that the particles are not frozen in position. However, the rotational flow of the adiabatic model does not exclude the possible existence in the nucleus of rotationally invariant clusters. As a particular example of such clustering, we propose a two-fluid model of nuclear rotations to describe the possibility of a centrally located rotationally invariant superfluid core. It is shown that the inertia tensor for rotational flow is the rigid-body tensor. But it is also shown that clusters would participate in the rotational flow as if they were elementary particles with their masses concentrated at their centers of mass and would thereby effect a reduction of the moments of inertia. Thus the fact that observed moments of inertia, for nuclei described by the adiabatic rotational model, are considerably smaller than the rigid-body moments evaluated for the nucleon mass distribution can be attributed to the presence of cluster correlations. The Inglis cranking model is examined in the light of this interpretation. (auth)

52669 VALIDITY OF THE STRUTINSKII SHELL-CORRECTION THEORY. Lin, Wing-fai (Univ. of California, San Diego, La Jolla). Contract AT(11-1)-Gen-10. Phys. Rev., C; 2: 871-6 (Sep 1970). (UCSD-10-P-11-104).

Realistic shell-model potentials were used to test Strutinsky's method. The results were strongly dependent on the shell-smearing parameter as well as the order of the curvature correction for smearing. No unambiguous values could be obtained for the shell correction, even with the effect of the continuum properly included. As a result, the Strutinsky theory should be regarded only as a recipe to be used in combination with Nilsson potentials. (auth)

52670 FADDEEV EQUATIONS FOR REALISTIC THREE-NUCLEON SYSTEMS. I. COMPLETE ANGULAR MOMENTUM REDUCTION AND ANTISYMMETRIZATION OF STATES. Harper, E. P.; Kim, Y. E.; Tubis, A. (Purdue Univ., Lafayette, Ind.). Phys. Rev., C; 2: 877-91(Sep 1970).

A complete angular momentum reduction of the Faddeev equations was carried out for the case of realistic, nonrelativistic three-nucleon systems with (local and/or nonlocal) interactions having general spin, isospin, and velocity dependence. Antisymmetrization of states with respect to particle exchange was properly accounted for by using properties of the permutation group and the isospin formalism. Expressions for the Faddeev equations, in the form of coupled two-variable integral equations, were obtained in two different coupling schemes; J-j [coupling of the (relative orbital plus total spin) angular momentum of a nucleon pair with the total angular momentum of the third nucleon (in the c.m. system) to give the total angular momentum (in the c.m. system)]; and L–S [coupling of the total orbital angular momentum (relative orbital angular momentum of a nucleon pair plus the orbital angular momentum of the third nucleon) in the c.m. system with the total spin angular momentum (total spin angular momentum of a nucleon pair plus the spin angular momentum of the third nucleon) to give the total angular momentum in the c.m. system]. (auth)

52671 FORMAL ASPECTS OF NUCLEAR MOMENT-OF-INERTIA THEORY. Friedman, William A.; Wilets, Lawrence (Princeton Univ., N. J.). Phys. Rev., C; 2: 892-902(Sep 1970).

Projected Hartree–Fock states were used as a representation in calculating nuclear wave functions. The rotational energy was determined consistently through $J(J+1)/\langle J^2\rangle$, and the moment of inertia thus obtained compared with expressions of other authors. The formulas of Peieris and Yoccoz and Thouless and Valatin yielded approximately the same results, but all of these formulas exhibit discrepancies with the Inglis independent-particle cranking-model formula. The spurious state $J_x|\phi\rangle$ plays a dominant role, in agreement with Banerjee, D'Oliveira, and Stephenson. Observations were made for the case of the soluble SU(3) model of Elliott. (auth)

52672 R-MATRIX EXPANSION FOR THE GROUND-STATE ENERGY OF A MANY-FERMION SYSTEM. Baker, George A. Jr.; Hind, Margaret F.; Kahane, Joseph (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., C; 2: 841-58(Sep 1970).

The R-matrix expansion for the ground-state energy of a many-fermion system was carried through fourth order. This expansion was evaluated for a potential modeled after the nucleon–nucleon one. The calculation is described in detail. The "hole-line" approximation seems to underestimate the attraction so that a hard-core force may well be consistent with the experimental binding energy of large nuclei. (auth)

52673 NUCLEAR ROTATION: CRANKING-MODEL CALCULATIONS AND THEIR RELATION TO OTHER TREATMENTS. Ma, Chin W.; Rasmussen, John O. (Yale Univ., New Haven). Phys. Rev., C; 2: 798-819(Sep 1970).

The generalized cranking model was used to study the corrections to the nuclear rotational spectra that cause it to deviate from the $I(I+1)$ rule. The fourth-order cranking corrections and the Coriolis-antipairing effect are treated as modes of a generalized vibration in the same way as the centrifugal stretching. The new form helps to explain the success of various two-parameter formulas used to fit the experimental energy levels and shows that they are equivalent. The parameters of such formulas are calculated here microscopically in a good-j basis, and they agree reasonably well with experiment. (auth)

52674 DROPLET MODEL NUCLEAR DENSITY DISTRIBUTIONS AND SINGLE-PARTICLE POTENTIAL WELLS. Myers, William D. (Univ. of Copenhagen, Univ. of California, Berkeley). Nucl. Phys.; A145: 387-400(1970).

A description is given of the nuclear density distributions and single-particle potential wells that arise in the course of Thomas–Fermi calculations of average nuclear properties. Simple expressions are given for the calculation of the essential characteristics of these distributions, and it is shown how the results obtained here may be used to approximate the densities and potential wells in terms of Fermi functions. (auth)

52675 WAVE FUNCTIONS NEAR RESONANCE AND R-MATRIX EXPANSION. Lejeune, A. (Univ., Liege); Mahaux, C. Nucl. Phys.; A145: 513-56(1970).

Some properties of many-channel scattering wave functions, of the eigenstates of R-matrix theory and of the R-matrix expansion are studied in the frame of an exactly soluble model. The dependence of the scattering wave function upon energy and entrance channel is investigated both formally and numerically. It is shown that only the closed channel components of the scattering wave function become approximately independent of the

entrance channel near resonance. The relation between the actual scattering wave function near resonance and the Gamow state of the Humblet–Rosenfeld theory is discussed. The exact eigenvalues, eigenstates and reduced widths of R-matrix theory are constructed and their dependence upon the choice of boundary parameters is studied. The elements of the R-matrix are computed and the convergence of the level expansion is investigated. The validity of various one-level approximations is analysed. The effect of a direct transition on the width of compound nuclear resonances is exhibited. (auth)

52676 NUCLEAR STRUCTURE WITH ELECTROMAGNETIC PROBES. Walecka, J. D. (Stanford Univ., Calif.). pp 1-17 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The use of electromagnetic interactions for studying nuclear structure is surveyed. Since inelastic electron scattering is the best tool for such studies, this interaction is discussed in detail. The various theoretical models for such studies are reviewed and some results are described. (J.W.R.)

52677 EXPERIMENTALIST COMMENTS ON ELECTRON SCATTERING. Isabelle, D. B. (Laboratoire de Physique Nucleaire, Clermont-Ferrand, France. Laboratoire de l'Accelerateur Lineaire, Orsay, France). pp 18-32 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The current status of nuclear structure research using electron scattering is surveyed. A brief summary of present trends in experimental facilities is given. The problem of radiative corrections is discussed in some detail. Elastic scattering, inelastic scattering, and quasielastic scattering are each discussed. (J.W.R.)

52678 LOW MOMENTUM TRANSFER ELECTRON SCATTERING. Beck, F. (Technische Hochschule, Darmstadt, Ger.). pp 40-7 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The place of low q-range electron scattering in nuclear structure research is described. The extraction of spectroscopic data from measured cross sections is discussed. Some recent results of low q inelastic scattering work are briefly discussed. (J.W.R.)

52679 ANALOGS OF GIANT RESONANCES FROM PHOTOPION PRODUCTION AND FROM MUON AND PION CAPTURE. Ueberall, H. (Catholic Univ. of America, Washington, D. C. Naval Research Lab., Washington, D. C.). pp 48-55 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Some calculations and experiments dealing with the analogs of giant resonances are described. The studies include muon capture, radiative pion capture, and inelastic pion photoproduction. (J.W.R.)

52680 DIPOLE CHARGE-TRANSFER EXCITATIONS IN NUCLEI. Goulard, B. (Univ. Laval, Quebec); Fallieros, S. pp 77-9 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Some properties of nuclear states resulting from dipole charge-transfer excitations are studied. (J.W.R.)

52681 PARTICLE AND PHOTON DECAY OF NUCLEI FOLLOWING ELECTROEXCITATION. Drechsel, Dieter; Ueberall, H. (Catholic Univ. of America, Washington, D. C.). pp 92-4 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The general angular correlation formulas for a coincidence experiment in which an electron, scattered inelastically by a nucleus, is detected simultaneously with a heavy particle or a photon emitted by the nucleus subsequently to its electroexcitation are derived. Nucleon emissions following electroexcitation in the giant resonance region of ^{12}C are studied as an example. (J.W.R.)

52682 MUONIC ATOMS AND NUCLEAR STRUCTURE. Engfer, Roland (Technische Hochschule, Darmstadt, Ger. CERN, Geneva). pp 104-21 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The use of muonic atoms in nuclear structure research is reviewed. The topics discussed include recent experimental improvements, corrections to binding energies of muonic atoms, intensities of muonic x-rays, determination of nuclear charge radii, hyperfine structure of muonic x-rays, and nuclear x-rays in muonic atoms. (81 references.) (J.W.R.)

52683 WEAK INTERACTION AND NUCLEAR STRUCTURE. Rho, M. (CEN de Saclay, Gif-sur-Yvette, France). pp 122-35 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A review on the use of weak interaction probes in studying nuclear structure is presented. The topics discussed include transitions to bound states, transitions with neutron emission, meson exchange effects, and nuclei as elementary particles. (30 references.) (J.W.R.)

52684 REMARKS ON MUON CAPTURE IN COMPLEX NUCLEI. Deutsch, J. P. (Univ., Louvain, Belg. CERN, Geneva). pp 136-43 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Some of the recent significant developments in the field of muon capture studies on complex nuclei are briefly highlighted. (J.W.R.)

52685 RESONANCE MECHANISM OF MUON CAPTURE BY COMPLEX NUCLEI. Balashov, V. V.; Eramzhyan, R. A.; Kabchnik, N. M.; Korenman, G. Ya.; Korotkih, V. L. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 174-6 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Some of the observables in muon capture by complex nuclei are discussed in terms of being evidence for a resonance mechanism. The properties discussed include neutron spectra and asymmetries, charged particle emission, and transitions to excited states of residual nuclei. (J.W.R.)

52686 GAMMA–GAMMA CORRELATION IN RADIATIVE NUCLEAR MUON CAPTURE. Oziewicz, Z.; Popov, N. P. (Ioffe Inst. of Physics and Tech., Leningrad). pp 185-7 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Angular gamma-gamma correlations after partial radiative muon capture with excitation of the daughter nucleus are studied. Calculations are performed for correlation coefficients in the framework of the UFI theory. (J.W.R.)

52687 PARTICLE CORRELATIONS AND HYPERFINE EFFECTS IN MUON CAPTURE. Popov, N. P. (Ioffe Inst. of Physics and Tech., Leningrad). pp 188-91 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The time dependence of the particle correlations in muon capture is studied. The calculations demonstrate that the dependence may be considerable at time intervals of the order of 1/R, where R is the conversion rate. (J.W.R.)

52688 NUCLEAR POLARIZATION IN DEFORMED NUCLEI. Chen, Min-yi (Columbia Univ., New York). pp 195-6 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).

From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

An effective quadrupole interaction is introduced to account for muonic and nuclear states not included when calculating muonic x-ray spectra in heavy deformed nuclei by diagonalizing the electric quadrupole interaction between muonic spin doublets and nuclear ground state rotational bands. In addition, an effective E1 transition matrix element is introduced for calculating the intensity ratios of the hyperfine multiplets. (J.W.R.)

52689 NUCLEAR EFFECTS IN MULTIPLE SCATTERING THEORY. Kohmura, Toshitake (Univ. of Rochester, N. Y.).

pp 338-40 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).
From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The nuclear effects on the transition operators and Green's function in multiple scattering theory are discussed. (J.W.R.)

52690 PIONS AND NUCLEI. Tanner, N. W. (Oxford Univ.). pp 346-66 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).
From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A review is presented on nuclear physics studies using pions. The subjects covered include low-energy nuclear physics, resonance pions, high-energy pions, and pion absorption and production. (62 references.) (J.W.R.)

52691 TWO-STEP REACTIONS IN NUCLEI. Pilkuhn, H. (Univ., Karlsruhe, Ger.). pp 443-5 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).
From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

Two-step processes in particle production reactions on nuclei are discussed. These processes include double charge or hypercharge exchange, hyperon production in proton-nucleus collisions, and η and η' production. (J.W.R.)

52692 $\pi^{\pm}$ ABSORPTION CROSS SECTIONS AND NEUTRON DENSITY PARAMETERS. Sternheim, Morton M. (Univ. of Massachusetts, Amherst). pp 455-7 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).
From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.
The use of the π^+/π^- absorption cross-section ratio for nuclei as a test of neutron density parameters is discussed. Calculations using an optical potential show that this ratio is sensitive to details of the neutron density. (J.W.R.)

52693 THEORETICAL DEVELOPMENTS IN THE FIELD OF π-MESIC ATOMS. Ericson, T. E. O. (CERN, Geneva). pp 488-96 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).
From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.
Some topics in the field of π-mesic atoms are discussed. The question of the anomaly in the π-nuclear interaction as a function of nuclear size and of the repulsive nature of the π-nuclear s-wave interaction is discussed in detail. Some results from a numerical analysis of π-mesic atoms are reviewed. (J.W.R.)

52694 NUCLEAR STRUCTURE INFORMATION FROM PION ABSORPTION EXPERIMENTS. Chung, K.; Danos, Michael; Huber, Max G. (Univ., Erlangen, Ger. National Bureau of Standards, Washington, D. C.). pp 533-4 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).
From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The use of pion absorption experiments to study nuclear structure properties is discussed. In particular, the use of pion absorption to study short-range correlations is discussed. A formulation in which the exchanged momentum distribution is to be obtained by experiment is described. (J.W.R.)

52695 P AND T VIOLATION IN NUCLEAR PHYSICS. McKellar, Bruce H. J. (Univ. of Sydney). pp 682-95 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).
From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The discussion of P and T violation in nuclear physics includes the use of parity violation in nuclei as a probe of the weak interaction Hamiltonian, parity violation as a nuclear structure probe, and T violation in nuclear physics. It is found that there is not sufficient agreement between the observations of parity violation to unequivocally conclude that it exists, but it seems likely that it does. (J.F.P.)

52696 EXPERIMENTAL INVESTIGATIONS OF P- AND T-VIOLATIONS. Hamilton, D. (Univ. of Sussex, Brighton, Eng. CERN, Geneva). pp 696-712 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).
From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

A survey is presented on experimental studies of P and T violations in nuclear physics. The studies on P violation include a parity violating transition in the α decay of the ^{16}O 8.88-MeV 2^- state, γ-ray asymmetries from polarized nuclei, γ-ray circular polarization, and Mössbauer experiments. Weak interaction tests, electromagnetic interaction tests, and detailed balance tests are discussed for T violation. In addition, tests for P_{odd} T_{odd} terms are discussed briefly. (J.W.R.)

52697 OPTICAL PROPERTIES OF NUCLEI AT VERY SHORT WAVELENGTHS. Gottfried, Kurt (Cornell Univ., Ithaca, N. Y.). pp 783-800 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).
From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The current theoretical ideas concerning interactions of electromagnetic radiation with nuclei are sketched and the present experimental situation is described. The topics covered include photon interactions with individual nucleons, coherent photoproduction of vector mesons, vector meson dominance, and nuclear optics and tests of vector meson dominance. (J.W.R.)

52698 BARYON RESONANCES IN THE NUCLEAR GROUND STATE: HOW ABOUT DOUBLE COUNTING? Danos, Michael (National Bureau of Standards, Washington, D. C.). pp 811-15 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).
From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.
A discussion is given of the difference between having a meson in the nucleus or having A-1 nucleons and one baryon resonance. The question of giving a consistent and precise meaning to the concept of particles is discussed, and an attempt is made to define a convergent approximation scheme, since an exact theory does not exist. (J.F.P.)

52699 BARYON RESONANCES IN NUCLEI. Kisslinger, Leonard S. (Carnegie-Mellon Univ., Pittsburgh). pp 816-24 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).
From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

In the discussion of baryon resonances in nuclei at high energies arguments are given suggesting that the degrees of freedom associated with baryon resonances must be explicitly included for the nuclear properties. The forces which bind baryon resonances to nucleons are discussed, and a review is given of the present evidence for the role of these resonances in high-energy backscattering of protons on deuterons. (J.F.P.)

52700 SOFT AND REAL PIONS IN NUCLEI. Ericson, M. (Institut de Physique Nucleaire, Lyon). pp 825-31 of High-Energy Physics and Nuclear Structure. /Devons, Samuel (ed.). New York; Plenum Press (1970).
From 3rd International Conference on High-Energy Physics and Nuclear Structure, New York. See CONF-690914.

The application of the soft pion theorem to nuclei is examined. The procedures for improving the approximations starting from the soft pion limit to reach the physical amplitude are described. (J.W.R.)

52701 RESOLUTION OF A PARADOX IN THE VARIATIONAL FORMULATION OF NUCLEAR-RESONANCE REACTIONS. Chatwin, R. A. (Florida State Univ., Tallahassee). Phys. Rev., C; 2: 1167-8(Sep 1970).

Lane and Robson have given a stationary-principle formulation of an approximation theory for resonance reactions. They stated a paradox in the stationary principle, which is resolved here in support of the approximation method. (auth)

52702 SCATTERING RESONANCES AND THE R FUNCTION. Takeuchi, K.; Moldauer, P. A. (Argonne National Lab., Ill.). Phys. Rev., C; 2: 920-5(Sep 1970).

The relationship between scattering resonances and R-function states was explored by investigation of the separate properties of the "hard-sphere" and "R-function" portions of the phase shift. The R-function states are good models for bound states and for some resonances below potential barriers, but they have no direct relation to scattering resonances above barriers. An R-function proof and explication are given for Levinson's theorem, according to which the number of scattering resonances is in general finite and small even though the spectrum of R-function states is infinite. Implications of the lack of high-energy resonances for the many-body problem are mentioned. (auth)

52703 SELF-CONSISTENT NUCLEAR CALCULATIONS WITH A DEFORMED BASIS. Tuerpe, D. R. (Univ. of California,

Livermore); Bassichis, W. H.; Kerman, A. K. Nucl. Phys.; A142: 49-62(1970).

The eigenfunctions of a cylindrically symmetric, deformed harmonic oscillator (h.o.) potential are used as a basis in which to expand Hartree-Fock orbitals. Self-consistent calculations for nuclei with $4 \leq A \leq 80$ are carried out in this basis and compared with results obtained with a spherical basis. It has been found that a rather large spherical basis must be used to obtain convergence for the quadrupole moment. It is shown that the use of a significantly smaller deformed basis produces the same result because of the extra degree of freedom, namely the ratio of the major and minor axes of the (h.o.) potential. The effects of including the Coulomb interaction are discussed and it is pointed out why previous calculations of Coulomb effects on the deformation are incomplete. (auth)

52704 UNIFIED MODEL OF DEFORMED ODD-ODD NUCLEI FOR NUCLEAR DATA GENERATION AND ANALYSIS. Fu, C. Y.; Yost, K. J. (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng.; 41: 193-208(Aug 1970).

A unified model of deformed odd-odd nuclei was formulated as an aid in nuclear data generation and evaluation. The model employs products of single-particle Nilsson wave functions as basis functions. The coupling of angular momenta of the odd nucleons is assumed to obey the Gallagher-Moszkowski coupling rules. The matrix elements of the proton-neutron residual interaction potential are evaluated with the use of oscillator brackets. The validity of the model was established by computing and comparing with experimental data nuclear energy levels and/or gamma-ray transition probabilities for ^{23}Na, ^{28}Al, ^{166}Ho, ^{182}Ta, and ^{238}Np. The calculated results compare quite well with experiment. Special attention was given to the establishment of an efficient computational method. (auth)

52705 SQUARE SUM OF NON-DIAGONAL MATRIX ELEMENTS OF ONE-BODY OPERATOR IN A SINGLE SHELL. Nomura, Masao (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 43: 235-7(Jan 1970).

Several expressions of use in the nuclear shell model are obtained, the most important of which is the reduction formula for the sum of the squares of non-diagonal matrix elements of a one-body operator in a single shell. (R.W.R.)

52706 CORRECTIONS FOR INHOMOGENEITY IN THE THOMAS-FERMI THEORY OF NUCLEI. Santos, E. (Univ. of Valladolid, Spain). Lett. Nuovo Cim.; 3: 469-72(11 Apr 1970).

Corrections to the kinematic energy in the Thomas-Fermi theory of nuclei are considered; the corrections are necessary because of the inhomogeneity of the potential used in the theory. It is shown that these corrections may enlarge the surface thickness by about 10% and contribute more than 1 MeV to the surface energy term in the Weizsacker mass formula. (R.W.R.)

52707 COEFFICIENTS OF FRACTIONAL PARENTAGE IN j-j COUPLING IN THE ISOSPIN REPRESENTATION. Hubbard, Lincoln B. (Oak Ridge National Lab., Tenn. Knoxville Coll., Tenn.). Contract AT(30-1)-2098. Comput. Phys. Commun.; 1: 225-31(Apr 1970).

This FORTRAN IV program evaluates the coefficients of fractional parentage (cfp) in the j-j coupling scheme for eigen-states of seniority, i-spin and total angular momentum. This program is applicable to any shell and can be used for fermions of only one type, e.g., electrons. The program uses a recursion relation for find the $n - (n + 1)$ cfp from a table of $(n - 1) - n$ cfp. This program is directly applicable to any j-j shell in the i-spin formalism or in maximum i-spin only. Storage required is 43,500 32-bit words. The $j = 7/2$ 4-5 cfp table (nearly 10,000 cfp, about half of which were zero) required 2 minutes on an IBM 360/91. (R.W.R.)

52708 PROGRAM TO CALCULATE A GENERAL RECOUPLING COEFFICIENT. Burke, P. G. (Queen's Univ., Belfast). Comput. Phys. Commun.; 1: 241-50(Apr 1970).

A FORTRAN IV program is described for calculating a general recoupling coefficient for an arbitrary number of integer or half-integer angular momenta. The program has application in atomic and nuclear structure or scattering calculations. The recoupling coefficient is first expressed as a sum over products of Racah coefficients multiplied by (-1) factors and $(2j + 1)^{\frac{1}{2}}$ factors. This summation is then evaluated. Storage required is 12,608 24-bit words. A run consisting of four recoupling coefficients with between 3 and 7 angular momenta takes about 4 seconds on an IBM 7090. (R.W.R.)

52709 THEORETICAL CALCULATIONS OF THE EQUILIBRIUM DEFORMATIONS OF NUCLEI. Sobiczewski, Adam (Inst. of Nuclear Studies, Warsaw). Postepy Fiz.; 21: 239-46(1970). (In Polish).

A method for calculation of the nuclear equilibrium deformations, based on the volume conservation condition, is described. Results of the calculations concerning quadrupole, hexadecapole and octupole deformations are reviewed. (auth)

52710 THE CONSERVATION OF SENIORITY IN THE $1g_{\frac{9}{2}}$ NEUTRON SHELL. Kitching, J. E. (McGill Univ., Montreal); Darcey, W.; Davies, W. G.; McLatchie, W.; Morton, J. M. Phys. Lett.; 32B: 343-5(3 Aug 1970).

The results of one- and two-neutron transfer reactions across the strontium isotopes are applied to a study of the conservation of seniority in the $1g_{\frac{9}{2}}$ neutron shell. (auth)

52711 IS THERE A LINEAR POLARISATION EFFECT CONTRIBUTING TO THE ISOMERIC SHIFT IN ROTATIONAL NUCLEI. Mang, H. J.; Meyer, J.; Speth, J.; Wild, W. (Technische Hochschule, Munich). Phys. Lett.; 32B: 321-2(3 Aug 1970).

Using the self-consistent cranking model to describe the isomeric shift in rotational nuclei, a linear polarization effect due to a change of the moment of inertia is shown to exist. This effect, however, does not arise in addition to the usual isomeric shift, but both effects are proven to be identical. (auth)

52712 NUCLEAR ROTATIONAL BANDS AND SL(3,R) SYMMETRY. Weaver, L.; Biedenharn, L. C. (Duke Univ., Durham, N. C.). Phys. Lett.; 32B: 326-30(3 Aug 1970).

An expression that involves no adjustable parameters for the ratios of interband E(2) transition probabilities in deformed even-even nuclei is derived. The derivation is based on the idea, due to Gell-Mann, that the relevant operators generate the algebra of SL(3, R). (auth)

52713 OFF-SHELL EFFECTS IN RANK-TWO SEPARABLE POTENTIALS. Srivastava, M. K.; Singh, Y.; Bhaduri, R. K. (McMaster Univ., Hamilton, Ont.). Phys. Lett.; 32B: 333-5 (3 Aug 1970).

A number of phase-equivalent, central, rank-two separable s-state potentials which yield the same deuteron binding have been considered recently by Fiedeldey in the calculation of triton binding energy. Here these are applied to nuclear matter. The variation in the calculated binding energy in nuclear matter is drastic and the trend in variation is opposite to that of triton. The implications of this are discussed qualitatively. (auth)

52714 GENERATOR-COORDINATE THEORY AS A FLEXIBLE FORMULATION OF THE MANY-BODY SCHROEDINGER EQUATION. Wong, Chun Wa (Oxford Univ. Univ. of California, Los Angeles). Nucl. Phys.; A147: 545-62(1970).

By using generator coordinates as state labels we formulate the generator-coordinate theory of collective motion as non-orthogonal representations of the many-body Schrödinger equation in a subspace of the Hilbert space of many-body state vectors. The weight function of the usual generator-coordinate theory is generalized to become the components of the state vector in one of the two bi-orthogonal representations labelled by generator coordinates. The well-known case of the Gaussian-overlap approximation is studied in order to show how the new formalism also permits a solution of the problem using the original real generator coordinates. The concept of generator coordinates is clarified by studying (i) the connection between the redundancy of generator coordinates and the linear dependence of base vectors labelled by these generator coordinates, and (ii) the construction of states having the required properties under translation and rotation. Finally, the consideration of rotational properties leads to a double-projection method for constructing internal states of good angular momentum and for removing spurious states of c.m. motion. (auth)

52715 GENERALIZED HARMONIC OSCILLATOR SHELL MODEL AND GENERALIZED OSCILLATOR TRANSFORMATION BRACKETS. Wong, Chun Wa (Univ. of California, Los Angeles). Nucl. Phys.; A147: 563-85(1970).

The motivation for using a generalized harmonic oscillator shell model with any number ($\leq A$) of different oscillator lengths and of separated centers of well is discussed. Formulas, including recursion formulas and expansion theorems, are obtained by means of generating functions for the calculation of matrix elements of many-body operators. Most of the generating functions in the model have a simple form, for which recursion formulas can be classified, enumerated, and given in simple standard forms. The simplicity of the generating functions also enables explicit expressions for the matrix elements to be written down in a number of equivalent ways. Of particular interest are the generalized two-body transformation brackets to the relative and c.m.

representation, with which matrix elements of a general two-body potential and of the Brueckner–Bethe reaction matrix can be calculated. A significant result is that the formulas in this generalized oscillator shell model are very similar to those in the usual oscillator shell model with unseparated centers of well. This means that relatively minor modifications of available computer codes will make possible calculations in the generalized oscillator shell model. The generalized oscillator wave functions can be used as quantum mechanical cluster wave functions and, more generally and also more satisfactorily, as generator-coordinate wave functions. It is hoped that these wave functions will be useful in problems of nuclear reactions as well as in those of nuclear structure. (auth)

52716 ISOVECTOR EXCITATIONS IN NUCLEI. Fallieros, S. (Brown Univ., Providence); Goulard, B. Nucl. Phys.; A147: 593-600(1970).

A discussion of the total intensities of isovector excitations in nuclei is presented. In addition to transitions of the electromagnetic type leading to states in the same nucleus, single charge transfer processes leading to states in the neighbouring nuclei are considered. In nuclei with an excess of neutrons, the three intensities are not simply related by rotations in isospin space. The relation of these intensities to the excitation strengths to states of definite isospin T, T + 1, and T − 1 is studied and explicit estimates are given for the case of transitions of the electric dipole type. (auth)

52717 COMPLEX ANGULAR MOMENTUM METHODS IN THE STUDY OF NUCLEON–NUCLEUS ELASTIC SCATTERING. Shanta, R. (Saha Inst. of Nuclear Physics, Calcutta. Bhabha Atomic Research Centre, Bombay); Satpathy, R. K. Phys. Rev., C; 2: 1279-92(Oct 1970).

The complex angular momentum technique was used to study nucleon–nucleus elastic scattering. Regge-type representations were developed for the scattering amplitude, taking the spin of the incident nucleon into account. The pole parameters were determined using the optical-potential parameters as input. With these pole parameters, the differential cross sections for elastic nucleon–nucleus scattering were calculated using an appropriate Regge-type representation for the partial-wave amplitudes. These studies give insight into the applicability of complex angular momentum methods to the optical model of elastic scattering of nucleons from nuclei. (auth)

52718 INVESTIGATIONS OF THE ACCURACY OF A SEPARABLE APPROXIMATION TO LOCAL POTENTIALS. Harms, Edward; Newton, Victor (Fairfield Univ., Conn.). Phys. Rev., C; 2: 1214-18(Oct 1970).

The unitary pole approximation (UPA) was applied to a number of spin-dependent local potentials and the separable potentials obtained were used to calculate the three-nucleon binding energy and scattering lengths. Excellent agreement was found between the binding energies obtained with the separable potentials and those calculated by Malfliet and Tjon using the local potentials. Simple analytic approximations are given for the UPA form factors, and comparisons are made between the local and the UPA two-body phase shifts. (auth)

52719 SLATER DETERMINANTS, PARITY PROJECTION, AND HARTREE–FOCK CALCULATIONS. Pacati, F. D.; Boffi, S. (Univ., Pavia, Italy. Istituto Nazionale di Fisica Nucleare, Pavia, Italy). Phys. Rev., C; 2: 1205-10(Oct 1970).

Slater determinants used in a standard Hartree–Fock calculation and built with parity-mixed single-particle orbitals do not have a definite parity; a parity projection after the variation is needed in general. A different solution is investigated here, in which the projection is performed before the variation. Conditions were studied for the case where the solution is still a Slater determinant. The results of explicit calculations for both methods were compared in the case of a three-nucleon system. A larger binding energy was obtained in the case of projection before variation, and in the corresponding solution (which is not a Slater determinant) considerable parity mixing in single-particle wave functions is allowed. (auth)

52720 DISCUSSION OF A NEW TECHNIQUE FOR SOLVING THE BETHE–GOLDSTONE EQUATION. Barrett, B. R. (Univ. of Pittsburgh); Hewitt, R. G. L.; McCarthy, R. J. Phys. Rev., C; 2: 1199-1204(Oct 1970).

The method of Truelove and Nicholls for obtaining reaction matrix elements for nuclear-structure calculations is discussed. In this method, the Bethe–Goldstone wave function is expanded in terms of eigenfunctions of two interacting nucleons bound in a common potential well. The Bethe–Goldstone equation, which is written in terms of an expansion over noninteracting two-particle states, is then solved iteratively. In practice, the method is most easily applied when a harmonic-oscillator basis is used; the Pauli operator Q can then be treated exactly. The convergence of the Truelove–Nicholls iteration scheme and of the above two expansions is investigated. It is shown that the original method is incorrect for nucleon–nucleon potentials with an infinite hard core. A simple way of correcting the method is presented. (auth)

52721 VARIATION OF THE R MATRIX. Mockel, A. J. (Univ. of Florida, Gainesville); Perez, R. B. Phys. Rev., C; 2: 1179-91(Oct 1970).

The R matrix of Wigner and Eisenbud is a function of a set of parameters (channel radii, boundary numbers, etc.) as well as of the energy of the incoming particle. Invariant imbedding techniques were applied, which give the variation of the R matrix with respect to changes of the parameters entering into the theory. A generalization of various formulas, derived originally by Wigner and Teichmann and Wigner, to the multichannel case was obtained. The general results apply also to deformations of the nucleus other than spherical. An application of the invariant imbedding technique is also shown concerning Robson's theory of the isobaric spin analogs. (auth)

52722 TRANSMISSION THROUGH A REAL POTENTIAL BARRIER TREATED BY MEANS OF CERTAIN PHASE-INTEGRAL APPROXIMATIONS. Froeman, Nanny; Froeman, Per Olof (Uppsala Univ.). Nucl. Phys.; A147: 606-26(1970).

The quantal problem of tunneling and super-barrier transmission through a real potential barrier is treated rigorously by means of certain phase-integral approximations. Given the wave function on one side of a smooth potential barrier, we derive both exact and approximate expressions for the wave function on the other side of the barrier and, under certain conditions, approximate expressions for the wave function inside the barrier. The case when the wave function is a standing wave is especially intricate and is discussed in great detail, since it has important applications in the treatment of scattering and decay problems. The case when the wave function represents an outgoing wave on one side of the barrier is also treated, and expressions for the transmission and reflection coefficients are given. (auth)

52723 TUNNELING AND SUPER-BARRIER TRANSMISSION THROUGH A SYSTEM OF TWO REAL POTENTIAL BARRIERS. Froeman, Nanny; Dammert, Oerjan (Uppsala Univ.). Nucl. Phys.; A147: 627-49(1970).

The one-dimensional quantal problem of tunneling and/or super-barrier transmission through a system of two potential barriers is treated rigorously by means of the higher-order phase-integral approximations introduced in a previous paper by one of the authors. These higher-order phase-integral approximations are closely related to the higher-order JWKB approximations but have great advantages compared to the latter approximations. General formulae for the transmission coefficient of a smooth double-barrier are given, pertinent to an arbitrary order of the approximations used. Upper bounds for the terms neglected in obtaining approximate formulae are derived. The case of resonant transparency is particularly considered. Approximate formulae for the wave function on the real axis, except in the vicinity of the transition points, are also given. In the last section the final formula for the transmission coefficient in the first-order approximation is given with all the notations explained, for the benefit of those interested in this particular result only. (auth)

52724 NEW APPROACH TO COLLECTIVE NUCLEAR MOTIONS. Morinigo, Fernando B. (California State Coll., Los Angeles). Phys. Rev., C; 2: 1255-60(Oct 1970).

The use of elements of the mass quadrupole tensor as generalized, nonredundant variables to describe nuclear collective motions was developed. The Hamiltonian for a group of n identical particles in an oscillator well, which interact with each other by way of quadrupole two-body interactions, is rewritten in terms of the eigenvalues of the mass quadrupole tensor and angular momentum operators. The total angular momentum is separated into a part associated with rotations of the mass quadrupole tensor and an intrinsic part. A semiclassical argument shows that the energies of states are approximately described by an expression in some respects indistinguishable from that of the empirical variable-moment-of-inertia model, which was found adequate to represent the energies of the levels of a wide range of even nuclei. (auth)

52725 EXTENDED SHELL-MODEL DESCRIPTION OF NUCLEON-TRANSFER FORM FACTORS. Philpott, R. J.

(Florida State Univ., Tallahassee). Phys. Rev., C; 2: 1232-43 (Oct 1970).

A flexible microscopic model was introduced in an attempt to illuminate problems associated with the calculation of single-nucleon-transfer form factors. The model employs a truncated shell-model basis augmented by a set of single-nucleon channels. It can be used even when the residual nucleus is unbound, but ignores contributions from many-particle breakup channels. The model wave function is fully antisymmetric, and it is shown that all quantities that appear in the model are calculable. An approximate single-channel calculation of form factors for the reactions $^{40}Ca(d,p)^{41}Ca(2.01\ MeV)$ and $^{40}Ca(^3He,d)^{41}Sc(2.10\ MeV)$ is used to illustrate some of the features of the model. (auth)

52726 NEW THEORETICAL APPROACH TO NUCLEAR HEAVY-ION SCATTERING. Wilets, L. (Univ. of Washington, Seattle); Goldberg, A.; Lewis, F. H. Jr. Phys. Rev., C; 2: 1576-7(Oct 1970).

Some recent calculations based on the statistical model employed the adiabatic assumption inconsistently. In particular, the high central repulsive core in ion-ion collisions is due to a trial density function, which leads to unphysically large densities in the close-in region. (auth)

52727 THEORY OF PAIRING VIBRATIONS. Goswami, Amit; Nalcioglu, Orhan (Univ. of Oregon, Eugene). Phys. Rev., C; 2: 1573-5(Oct 1970).

The bootstrap theory was applied to the case of pairing vibrations; an approximation used by Dang and Klein in their treatment of pairing is shown to be consistent with the bootstrap theory. A modified Tamm-Dancoff approximation is described. The numerical results for $^{58,60,62}Ni$ are compared with the exact solutions and with the results of Dang and Klein. (auth)

52728 ROTATIONAL SPECTRA OF THE GROUND-STATE BANDS OF EVEN NUCLEI BY THE GENERATOR-COORDINATE METHOD. Onishi, Naoki (Florida State Univ., Tallahassee); Sheline, Raymond K.; Yoshida, Shiro. Phys. Rev., C; 2: 1304-18(Oct 1970).

The generator-coordinate method was applied to the rotational spectra of the ground state of even nuclei. The trial functions were generated from the Nilsson well, taking into account pairing correlations for fixed values of the deformation parameter δ. This wave function was projected onto eigenstates of angular momentum and used to evaluate the expectation value of the Hamiltonian, which consists of the kinetic energy and the interactions between nucleons. A Gaussian form with Rosenfeld mixture was assumed for the nucleon-nucleon potential. Numerical calculations were performed for isotopes of Hf. Without changing the values of parameters, characteristic features of the energy spectra were reproduced and agreement with experiment is good. The quadrupole moments of various rotational states, as well as E2 transition matrix elements, were also calculated. To make more extensive comparisons, the kernels used in these calculations were expressed in terms of parameters, which were selected to give agreement with experimental spectra up to the second excited states for each isotope. Then energy spectra were calculated using these adjusted parameters for all rotational nuclei with mass number greater than 100. Good agreement with experimental data was obtained. (auth)

52729 NOMOGRAM FOR DETERMINING THE ENERGY OF BYPRODUCTS FROM I + II = 1 + 2 AND Q REACTIONS. Potetyunko, G. N. This paper was summarized in At. Energ. (USSR); 27: 221-2(Sep 1969) as paper No. 341/5347. (In Russian).

A method is described for constructing a nomogram for kinematical calculations on binary-type nuclear reactions. Almost no preliminary calculations are necessary for construction of the nomogram. (J.W.R.)

52730 NUCLEON TRANSFER REACTIONS BELOW THE COULOMB BARRIER. Trautmann, D.; Alder, K. (Inst. of Theoretical Physics, Basel). Helv. Phys. Acta; 43: 363-92 (1 Jul 1970).

A DWBA treatment for nucleon transfer reactions is given which is applicable for energies below and in the neighborhood of the Coulomb barrier. At energies well below the Coulomb barrier the theory is essentially exact and the radial integrals describing the reaction may be evaluated analytically by means of generalized hypergeometric series. Methods for their numerical calculation are given. Semiquantal and semiclassical approximations are considered. From those it is possible to recognize a close similarity between transfer processes and Coulomb excitation. The effects of nuclear interaction, which become important at energies close to the Coulomb barrier, are treated in an approximate manner. Expressions are given for the differential and total cross section. The deuteron stripping reaction is treated as a special case and the polarization of the outgoing proton in (d,p)-reactions is calculated. The connection between this treatment and the diffraction model developed by Dar and Frahn and Sharaf is discussed. An improvement of the model is given. A method similar to the one used in scattering and Coulomb excitation calculations is used to improve the slow convergence of the sum over the orbital angular momenta. Comparisons with actual experiments are discussed. (auth)

52731 ONE-PARTICLE STATES OF THE FISSILE NUCLEUS. Marshalkin, V. E. (Tomsk Polytechnic Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 52-5(1970). (In Russian).

Perturbation theory and the quasi-classical approximation were used to derive equations for the energies of single-particle levels in the transition region for all geometrical shapes of fissioning systems. (R.V.J.)

52732 ENERGIES OF QUARTET STRUCTURES IN EVEN-EVEN N = Z NUCLEI. Arima, Akito; Gillet, Vincent; Ginocchio, Joseph (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Phys. Rev. Lett.; 25: 1043-6(12 Oct 1970).

Mass relationships are used to compute the energy of quartet excited states in N = Z even-even nuclei for ^{12}C up to ^{52}Fe. The states obtained are quasibound up to excitation energies of about 40 MeV and could account for the narrow structures recently observed in heavy-ion transfer experiments. (auth)

52733 INFORMATION ABOUT SHORT-RANGE NUCLEON-NUCLEON CORRELATIONS FROM (γ,pn) COINCIDENCE EXPERIMENTS. Weise, W. (Univ., Erlangen, Ger.). Lett. Nuovo Cim.; 4: 541-4(19 Sep 1970).

An experiment is proposed which can be interpreted most directly in terms of short-range nucleon-nucleon correlations. An incoming photon is absorbed by a proton-neutron pair in the target: the case is considered where the two nucleons are emitted at the same angle and energy. The nucleus is assumed to be described by an independent-particle model modified to account for the characteristic short-range behavior of the nucleon-nucleon potential. The following results were obtained: The quantitative features of the angular distributions of the emitted nucleons are determined essentially by the center-of-mass motion of the p-n pair; the magnitude of the differential cross section is determined by the distribution of the relative momentum between the two bound nucleons and hence depends sensitively on the correlation parameter; the ratio of the differential cross sections at a given geometry is uniquely related to the momentum distribution of the relative motion of the proton-neutron pair. (R.W.R.)

52734 VARIATIONAL CONSIDERATION IN ANALOG RESONANCES. Futami, Yasuhiko (Science Univ. of Tokyo, Chiba, Japan). Progr. Theor. Phys. (Kyoto); 41: 1118-19(Apr 1969).

The normal mode analysis of excited states using the equation of motion has been put into the frame of the modified variational treatment. It is shown that this method can be applied to the description of isobaric analog resonances and Gamow-Teller resonances, and that the Coulomb energy shift and the resonance width can be derived from a variational consideration. (R.W.R.)

52735 GENERATOR COORDINATE TREATMENT OF COMPOSITE PARTICLE REACTION AND MOLECULE-LIKE STRUCTURES. Horiuchi, Hisashi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 43: 375-89(Feb 1970).

A generator coordinate method as a numerically tractable alternative to the resonating group method for treating the composite particle reaction and for the study of the molecular model of nuclear structure is proposed. The wave function used by Margenau and Brink in their α-particle model is adopted as a trial function, and the problem of the relative motion between composite particles is discussed. A method of transformation of the generator function to the wave function of the relative motion is given, and it is shown that the solutions of the generator coordinate method include that of the resonating group method in the interaction region. The boundary condition constraint method is used to obtain the scattering amplitude. As an example, the procedure is applied to the phase shift calculation of the $\alpha-\alpha$ scattering case, and good agreement with experiment is obtained. The density localization in the molecular model can be adequately formulated in this method, since this method has a direct connection with the concept of intrinsic deformation. Some quantitative analyses are given of the α-particle widths of ^8Be by the method of generator coordinates. The results provide evidence for the molecule-like structure of this nucleus. (auth)

52736 CORRECTION TERM FOR THE BINDING ENERGY FORMULA OF IDENTICAL NUCLEONS IN A SINGLE j SHELL. Nomura, Masao (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 43: 555-6(Feb 1970).

The binding energy (BE) of an identical nucleon system in a j shell is given by $BE = a + b[n(n-1)/2] + [2(j+1)c/2j+1](n/c)$. A correction term to this expression due to seniority mixing is derived by use of the second-order perturbation method. It is also shown that the BE of nuclei near the midshell should be larger than expected from the above expression; this is verified in the Ca isotopes. The perturbation method cannot, however, be satisfactory when the long-range component of the interaction is very large. (R.W.R.)

52737 EXPRESSION FOR THE THIRD MOMENT OF THE NUCLEAR HAMILTONIAN IN TERMS OF TWO-BODY MATRIX ELEMENTS. Nomura, Masao (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 43: 857-9(Mar 1970).

It is shown that, by using relations concerning the additional quantum number α, the third moment of the nuclear Hamiltonian $\langle 0|H^3|0\rangle$ can be obtained in terms of two-body matrix elements without recourse to coefficients of fractional parentage: this is true so long as the state $|0\rangle$ is simple enough to allow evaluation of $\langle 0|H^2|0\rangle$. This treatment of the third moment of the Hamiltonian can be successfully used in the variational treatment. (R.W.R.)

52738 MOSZKOWSKI'S RELATION AND THE SECOND MOMENT OF ENERGY FOR A GIVEN SENIORITY OR ISOSPIN IN A SINGLE SHELL. Nomura, Masao (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 43: 556-7(Feb 1970).

The width for n particles in l-shell can be represented in terms of the width for two particles. This relation for the special case of four particles in a j-shell is proved in an original way. It is shown that the width and second moment of energy for a given seniority may be expressed solely in terms of the two-body matrix element of the interaction. It is also possible to express the width and the second moment of energy for a proton–neutron configuration j^4 with a given isospin in terms of only two-body matrix elements. (R.W.R.)

52739 ^{32}S NUCLEUS IN A BOSON APPROXIMATION MODEL. Castel, B.; Chan, H. H. (Queen's Univ., Kingston, Can.). Progr. Theor. Phys. (Kyoto); 43: 854-6(Mar 1970).

^{32}S is considered in the context of a boson approximation model for nuclear pairs in even–even nuclei. The values of the coupling constants obtained are consistent with the description of a vibrational nucleus. Excellent agreement between calculated and experimental spectra is obtained with one single adjustment; namely, the value of the energy of the first 2^+ state is taken from experiment. The calculated electromagnetic properties of the excited states are in general agreement with the experimental results. Although this model has some shortcomings (such as neglect of the Pauli principle), it is able to reproduce the main features of the low-lying spectrum of a light vibrational nucleus like ^{32}S. (R.W.R.)

REACTOR TECHNOLOGY

Commercial Power Reactors

Refer also to abstracts 51197, 51198, and 52893.

52740 (AE-402) APPLICATION OF PSEUDO-RANDOM SIGNALS TO THE AGESTA NUCLEAR POWER STATION. Bliselius, Per-Ake (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1970. 30p. Dep. CFSTI (U. S. Sales Only).

The Agesta dynamic experiments comprise step responses and transfer functions measured from perturbations in reactivity and steam load. The main results are presented. A comparison is made with predicted results from an analog model of the Agesta reactor. The generation of pseudo-random binary sequences (PRBS) is discussed, particularly those based on the quadratic residue sequence. Some of the properties of the PRBS as a dynamic test signal are given. Practical considerations in designing PRBS experiments for application to nuclear power reactors are discussed. Experience from different methods of analysing periodic PRBS measurements is presented. It is shown that the direct and the indirect Fourier analyses are equivalent as far as discrimination against noise is concerned. Comparison with the maximum likelihood identification technique when using the PRBS as a test signal is also discussed. 35 references. (auth)

52741 (ANL-7685, pp 272-89) BIG ROCK POINT VIBRATION ANALYSIS. Corr, J. E. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14-15, 1970.

Vibration problems with the Big Rock Point reactor thermal shield are described. The mathematical analysis on which the diagnosis and remedial action for the vibrations was based is presented. (H.D.R.)

52742 (GA-10200) BUTTONHEAD ANCHORAGE OF TENDON WIRE FOR THE FORT ST. VRAIN PRESTRESSED CONCRETE REACTOR VESSEL. Hildebrand, J. F. (Gulf General Atomic, Inc., San Diego, Calif.). 22 Jun 1970. Contract AT(04-3)-633. 94p. Dep. NTIS.

The Fort St. Vrain reactor uses a prestressed concrete reactor vessel (PCRV) to contain the reactor core, the helium primary coolant, the helium circulators, and the steam generators. The prestressing forces are provided by a system of 448 posttensioned, nongrouted tendons. These tendons, which consist of 169 high-strength 0.250-in.-diameter wires, depend on the positive anchorage of the cold-upset buttonheads as well as the tensile and stress-relaxation properties of the wire. The ability of the buttonhead to support the ultimate tensile strength of the wire was investigated. These investigations included (1) a review of the wire manufacturing process, (2) the characteristics and properties of the finished wire, (3) the types and methods of forming buttonheads, (4) the effect of malformations and imperfections on the strength of the buttonheads, and (5) metallographic examinations of the various conditions that occurred during the test programs and during fabrication and installation of the tendons. The results of the 3-year test program confirm that the buttonheads provide the positive wire anchorage needed. 14 references. (auth)

52743 (GAMD-9768) PROPOSED ANALYSIS AND INTERPRETATION OF THE FORT ST. VRAIN PLATEOUT PROBES. Vanslager, F. E. (Gulf General Atomic, Inc., San Diego, Calif.). Aug 1970. Contract AT(04-3)-633. 27p. Dep. NTIS.

The design, analysis, and interpretation of the two replaceable plateout probes to be installed in the Fort St. Vrain reactor circuit are discussed. The probes are located at the inlet to two steam generators, one in each coolant loop. Samples of both the core outlet and core inlet coolant streams of each of the two coolant loops are continuously bypassed through the probes. During shutdown for refueling, the plateout probes can be removed through the PCRV penetrations at each probe location and subjected to gamma spectroscopy and radiochemical analysis. The activity profiles on the diffusion tubes and sorption beds located inside the probes are used to determine the amount, distribution, and chemical forms of the ^{90}Sr inventory in the reactor circuit. It is anticipated that the ^{90}Sr inventory might be composed of three components: a gaseous component, a dust-borne component, and a noble-gas precursor component. Equations to determine each of these components from the plateout probe data are presented. (auth)

52744 (GAMD-9984) CROSSFLOW CALCULATION FOR THE FORT ST. VRAIN NUCLEAR REACTOR CORE. Kiefer, R. J. (Gulf General Atomic, Inc., San Diego, Calif.). Aug 1970. Contract AT(04-3)-633. 41p. Dep. NTIS.

The crossflow factors derived by utilizing simple, easily converged FLAC models give crossflow factors that are consistent with the three parameters on which the crossflow correlation is based: orifice setting, radial power factor, and age. Comparisons between a whole-core FLAC model and the POKE model utilizing the correlation agree well in most but not all regions. This has been attributed to the probable lack of complete convergence in data from the whole-core FLAC model. (auth)

52745 (STI/PUB-274) INSURANCE FOR NUCLEAR INSTALLATIONS. Legal Series No. 6. Reports and Documents Resulting from a Panel of Experts Convened by the International Atomic Energy Agency in Vienna, 24-28 November 1969. (International Atomic Energy Agency, Vienna (Austria)). 1970. 189p. IAEA $5.00.

The Panel on Nuclear Insurance, convoked by the Director General of the International Atomic Energy Agency, met at the Agency Headquarters from 24 to 28 November 1969. The Panel discussed the risks incurred in the construction and operation of nuclear power plants and methods of financial coverage for such risks. It considered problems of international and national law related to third party liability for nuclear damage as well as insurance and other financial security required therefor. Questions of workmen's compensation (social security) for radiation damage suffered by the personnel of nuclear installations were also discussed. Damage to the nuclear plant itself and other on-site property was equally considered. A number of papers on the various subjects submitted by the advisers, prepared by the Secretariat or collected by it, were in part presented orally and formed the basis of Panel discussions. The experts reported on the legal situation regarding liability and insurance for nuclear damage in their respective home countries. (auth)

52746 (TID-8200(22nd Rev.)) NUCLEAR REACTORS BUILD, BEING BUILT, OR PLANNED IN THE UNITED STATES AS OF JUNE 30, 1970. (Office of the Assistant General Manager for Reactors (AEC), Washington, D. C.). 40p. CFSTI.

Data on U. S. facilities capable of sustaining a nuclear chain reaction are tabulated. The reactors and critical assemblies are categorized by primary function, and statistics tabulated include name, owner, location, principal contractor, type, power, startup date, and shutdown date. (H.D.R.)

52747 (ZJE-88) TEST EQUIPMENT DESIGN FOR DIRECT DETERMINATION OF FISSION ENERGY DISTRIBUTION IN A FUEL ELEMENT OF THE FIRST CZECHOSLOVAK NUCLEAR POWER PLANT. Kott, J.; Jirousek, V.; Teren, S. (Skoda Concern, Pilsen (Czechoslovakia). Nuclear Power Plants Div.). 1970. 10p. Dep. NTIS (U. S. Sales Only).

A direct method for measuring the heat generation in the U fuel pin for Bohunice Power Reactor Unit 1 is described. For verification of this method a special calorimetric sound test was designed. The calorimetric probe construction is described. 4 references. (auth)

52748 ELECTRICITY PRODUCTION AND SUPPLY [IN THE USSR]: PRESENT ACHIEVEMENTS AND DEVELOPMENT PROSPECTS. Aleksenko, G. V. Elektrichestvo, No. 4, 1-10(Apr 1970). (In Russian).

The USSR now produces more electricity than England, France, W. Germany and Italy combined—about 690×10^9 MWh in 1969 (installed capacity 154,000 MW at 1 Jan. 1970), with the prospects of 740×10^9 MWh in 1970 (12,000 MW of new capacity envisaged). Thermal stations generate 83% of the power (hydro 16%, nuclear 1%). (U.K.A.E.A. Info. Bulletin)

52749 USSR NUCLEAR POWER PROGRAM: REPORT OF THE U. S. REACTOR DELEGATION. Nucl. News; 13: No. 10, 18-26(Oct 1970).

Design and development programs for research and power reactors in the U.S.S.R. are reviewed. Reactors described include: BN-600; BN-350; BOR-60; BR-5; BFS-2; Novo Voronezh Power Reactor; VK-SO Reactor; and the Beloyarsk Power Reactor. (D.C.C.)

52750 PROGRESS ON THE PROTOTYPE FAST REACTOR (PFR). Campbell, R. H. (Nuclear Power Group, Risley, Eng.). pp 19-22 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The Prototype Fast Reactor has reached the stage where design work on the major items is complete, the building and civil work at site is complete apart from the fuel-handling caves, and manufacture of all major components is well advanced. The progress which has been made and the changes which have occurred to the original concept due to further design and development work are reviewed. (auth)

52751 DEVELOPMENT AND OPERATION OF SODIUM TEST RIGS FOR PFR COMPONENTS. Eickhoff, K. G.; Dickinson, K.; Hamer, A. N. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 41-54 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The further operating experience with the sodium rigs at the Risley Engineering and Materials Laboratory is reviewed. New rigs constructed since that date are described. The Pump Test Rig has continued to operate reliably and over 9000 hours operation have now been achieved. After completion of the pump trials the rig was modified to permit the calibration of flowmeters for the Prototype Fast Reactor and a 150-mm dia. bypass loop has been added for cavitation experiments. After some initial difficulties with high-temperature flanged demountable joints had been satisfactorily overcome, the Fuel Element Test Rig has operated reliably and over 6000 hours operation at 650°C has been achieved. The discovery of serious local corrosion due to a small high-temperature Na leak has led to the development of an improved system for detecting leaks. The Components Test Loop, which was commissioned in 1967, is described. It supplies eight test sections of greatly differing size with clean Na at 400°C. The technical problems of ensuring the safe operation of this complicated rig under all possible combinations of normal and fault conditions in the test sections has proved severe, and it may be that the limit of size and complexity for this type of rig has been reached. A new 25-mm dia. Na loop for general development work was commissioned in 1968. It supplies up to four independent sub-loops with clean Na at 400°C. 7 references. (auth)

52752 HYDRAULIC PROBLEMS IN THE PFR COOLANT CIRCUIT. Laithwaite, J. M. (United Kingdom Atomic Energy Authority, Risley, Eng.); Taylor, A. F. pp 75-85 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The Prototype Fast Reactor (PFR) is an integral system with the major components of the primary circuit, the core, the pumps and the intermediate heat exchangers all immersed in a sodium pool with a free surface. The compactness of the design and consequent high coolant velocities have produced a number of fluid dynamics problems which include flow-induced vibration, gas entrainment at the free surface and cavitation. The design problems, the solutions and the supporting development work are described. (auth)

52753 SELECTION OF A HYDRAULIC DESIGN FOR FAST NEUTRON REACTORS. Rineiskii, A. A.; Karpov, A. V.; Pyshin, V. K. (Inst. of Physics and Power, Obninsk, USSR). pp 107-21 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970). (In Russian).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

Various types of hydraulic designs for fast neutron reactors with an integral layout in the primary circuit are discussed. An analysis is made from the point of view of the possible operation of a nuclear power station in conditions other than nominal (normally scheduled or emergency cut-out of some of the components) and of the quantity, type and speed of response of the cut-off devices (check valves, gate valves). Procedures are suggested for calculating the hydrodynamic processes of interest in the primary circuit of the facility. The results, which are obtained in dimensionless form, provide information on the hydraulic processes occurring in the BN-600, PHENIX and PFR reactors, which have a primary circuit of integral design, and similar hydraulic characteristics. The following design features of these reactors were used as the basic data for the analysis: three-beat extraction loops; a hydraulic resistance in the reactor of about 80% of the total resistance of the circuit, and a check valve in the form of a very simple flap mounted in the vertical section of the circuit. 6 references. (auth)

52754 DESIGN OF THE REACTOR VESSEL FOR THE SNR-PROTOTYPE. Koehler, M.; Rothfuss, H. (INTERATOM, Bensberg, Ger.). pp 139-48 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The reactor vessel for the Belgian-Dutch-German 300-MW(e) sodium-cooled fast reactor power station is described. For the vessel, including the top shield, some design requirements and an overall description are given. The SNR is a loop system with 3 primary circuits. The vessel has a diameter of 6.2 m and a height of 14 m. All pipes penetrate it above an emergency level, which is, in case of a vessel leak, insured by an additional guard vessel. The vessel is closed by a triple rotating top-shield system. For this system the development work is explained, including the SNR-engineering mock-up with an almost full-size top-shield model. For the inlet pipe arrangement, which is one of the important points for determining the vessel design, the considerations concerning alternative solutions are discussed. 6 references. (auth)

52755 PFR CORE SUPPORT. Jackson, G. O. (Nuclear Power Group, Risley, Eng.); Betts, C.; Buckley, F. pp 273-81 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The specifications of the restraint required on core and sub-assembly movement in terms of the reactivity effects of core tolerances and the need to charge and discharge the reactor are described. Experimental work to underwrite the method of support and to determine the movements caused by flow in the sub-assemblies is also covered. In Pu-fueled fast reactors the delayed neutron fraction is about one-third of that in a U-fueled reactor. This makes Pu reactors three times as sensitive to short-term core dimensional changes than an equivalent U reactor. The requirements to be met in the maintenance of core geometry are, therefore, severe and steps have to be taken to ensure that such movement is strictly limited. This limitation has to be balanced against the tolerance with which the sub-assemblies can be made and the need to charge the reactor. Most fast reactors depend on either some form of external clamping to restrict movement, which can cause large thermal stresses, or use support pads at or near the core center-line associated with a long spike to restrict movement. In PFR, the sub-assemblies are loaded against a control-rod guide support in groups of six sub-assemblies to one control rod. This avoids any accumulation of tolerances across the reactor and any interaction effects between one group of sub-assemblies and another. Large clearance for sub-assembly swelling and distortion can then be provided. (auth)

52756 SODIUM PUMP FOR FAST REACTORS. Laithwaite, J. M. (Nuclear Power Group, Risley, Eng.); Bowles, L.; Delves, P. H. pp 319-30 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

Mechanical pumps are to be preferred over electrical pumps for large systems. Experience of pumping sodium from a 6000-gallon/minute centrifugal pump is reviewed. The conceptual design of the primary and secondary pumps for the PFR and the choice of drive are analyzed. The cavitation problem is considered and difficulties in interpreting results from the 6000-gallon/minute loop are described. These results led to a change in design of the primary PFR impeller shortly after placing the contract in order to reduce the cavitation problem. Detail aspects of the mechanical design are considered. The bearing arrangement and development work required to establish the hydraulic performance are described. (auth)

52757 USE OF STABILIZED STEELS IN THE PFR CIRCUIT. Watkins, B.; Dickinson, F. S.; Turner, F.; Jackson, H. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). pp 397-416 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

Cost considerations and the risk of stress-corrosion cracking make ferritic steels the preferred structural materials for the evaporator tubing of the PFR steam generator. Steels containing carbide stabilizers are, however, necessary due to decarburization and consequent loss of strength on exposure to Na. An optimization study of the mechanical properties of stabilized steels led to the selection of a Nb-stabilized 2¼ Cr-1 Mo steel for the evaporators and a stabilized mild steel for other components. Stabilized steels have been used for neutron-shield tubes, evaporator boiler tubes and some secondary circuit components. Thus, stabilized steels have been used as plates, tubes and forgings. Fabrication experience with these components is discussed. The high integrity requirements of boiler components necessitate par-

ticular attention being paid to tube/tube plate welds. Despite the exceptionally high level of quality control applied to these welds, both radiographic and ultrasonic techniques were developed to supplement visual inspection and leak detection. The application of these techniques to stabilized steel welds is discussed. 8 references. (auth)

52758 PROTOTYPE FAST REACTOR HEAT-TRANSPORT SYSTEM. Taylor, D. (Nuclear Power Group, Risley, Eng.). pp 455-70 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

Knowledge gained in the actual procurement and preparation of approved operating instructions of sodium-heated steam generators, intermediate heat exchangers and the secondary sodium circuit for the Prototype Fast Reactor (PFR) is reviewed. A few minor additions to the pipework and control systems made to facilitate smooth and efficient start-up from various shut-down conditions are described. In common with all other shell-and-tube heat exchangers a critical area existed in the steam generators and intermediate heat exchangers at the tube-to-tube-plate joints, both from a thermal transient and manufacturing point of view. Some aspects of the development work and production control leading to confirmation of the chosen design of joint are outlined. The success is so far reflected in the achievement of sound welds under stringent quality control and non-destructive testing in production. The confirmatory development program investigating the thermal and flow conditions in the Na circuits and heat-exchanger units under various modes of operation is close to completion. The results to date, which give no major cause for concern, are discussed in terms of correlation with similar experimental work and the effects upon PFR operation. The provisions made for detecting a water leak into the Na and for taking corrective action without damage to the equipment or danger to personnel if a leak should occur are described. The prediction of the conditions that may exist during a water-to-Na leak have been the subject of analytical and development work. Some of the main results and how they might affect operation and maintenance are discussed. (auth)

52759 MECHANISMS IN SODIUM. Delves, P. H. (United Kingdom Atomic Energy Authority, Risley, Eng.); Rodwell, W. pp 757-70 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

A program of development work performed in support of the fuel charge machine for the Prototype Fast Reactor (PFR) is described. The machine has a number of distinctly identifiable working parts, some submerged in the reactor sodium, some in the cover gas. The decision to proceed on the basis of exposed mechanisms grew largely out of confidence arising from experience with the Dounreay Fast Reactor (DFR). From a preliminary basic design of the charge machine its various functional requirements were identified and specific types of mechanisms were selected for each. A series of individual experimental programs was embarked upon to establish satisfactory design parameters for these mechanisms and to evaluate their performance characteristics and durability in the reactor. A brief description is given of the charge machine together with its operational requirements and relevant design parameters. Details are given of the development programs which included preliminary sorting experiments followed by performance and life testing and finally simulated the total treatment which the machine will receive in operation. 6 references. (auth)

52760 DESIGN CRITERIA, DESCRIPTION, AND TEST PROGRAM OF THE SNR-PROTOTYPE FUEL-HANDLING SYSTEM. Althaus, D.; Mohm, F.; Wagner, J. (INTERATOM, Bensberg, Ger.). pp 771-86 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

A comparison of different handling systems has resulted in the following design criteria for the SNR-prototype: intermediate storage of fuel in the reactor vessel; all handling operations in the reactor vessel take place during reactor shut-down at intervals of about four months; handling in the vessel by a triple rotating-plug top shield; and cooling of spent assemblies by gas after leaving the vessel. Spent assemblies will be transferred from the reactor vessel to ex-vessel storage and, when the reactor is operating, loaded in helium-filled casks and shipped to the reprocessing plant. Handling equipment is installed in a special handling building. Transfer of irradiated material between the containment and the handling building takes place during reactor shut-down, via shielded handling machines. A special test facility is being constructed to stimulate handling operations in the reactor vessel and to test handling equipment under sodium. In addition, experience of KNK operation tests is available. 5 references. (auth)

52761 BURST PIN DETECTION (BPD) EQUIPMENT. Hackney, S. (Nuclear Power Group, Risley, Eng.); Wood, J. T. pp 853-65 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The equipment used in the application of delayed-neutron monitoring to the Na-cooled Prototype Fast Reactor (PFR) is described. The development and testing of components prior to final design and manufacture are reviewed. The equipment consists basically of means to present a sample of reactor coolant to groups of neutron counters which will detect any changes in the neutrons present in the coolant. This equipment detects failed fuel pins in the reactor core as soon after the event as is practical; provides permanent data on fuel performance and reliability; shuts down the reactor in the event of fuel failures of such magnitude as to make possible progressive fuel-pin failures leading to a blocked channel. There are two separate systems denoted as the "Bulk System" and the "Bulk and Location System." The Bulk System extracts samples of Na from the outlets of each of the six heat exchangers and transports this sample to the sampling chamber outside the biological shield. The sampling chamber is ringed by BF_3 counters to monitor the neutron activity. The Bulk and Location System extracts samples of sodium from the outlet of each of the 186 fuel channels which make up the core of the reactor. These samples are again transported to a similarly situated sampling chamber. Interposed between the fuel channel and the sampling chamber is a selector valve which selects each sample in turn and directs this to a separate sampling chamber. This arrangement allows for individual assessment of each coolant channel making it possible to locate fuel channels containing burst fuel pins. Electro-magnetic pumps are used to drive the coolant samples around the circuits operating at 430°C. Flow-measuring devices are fitted to detect any changes in the flow of samples. Each bulk neutron-detector system consists of three separate groups of BF_3 counters, to enable a reactor trip to be operated on a two out of three system. The display of the information is integrated into the data-reduction equipment used for the whole station and is available to the operator by selection for viewing on cathode-ray tubes or more permanent print-out. (auth)

52762 MODES OF EMERGENCY COOLING OF THE SNR. Evers, H.; Himmel, T.; Huebel, H.; May, O.; Metzner, H.; Muenster, H. (INTERATOM, Bensberg, Ger.). pp 867-82 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

Emergency cooling includes all situations in which the normal dissipation of reactor decay heat is disturbed by unintended or hazardous conditions. Modes of emergency cooling are, therefore, to be defined in a wide range of accident conditions which cover non-dangerous situations such as the failure of a pump as well as large ruptures in the heat-transfer system. The total loss of electrical power supply to the pump motors activates the diesel sets. Loss of power or seizure of one primary pump causes a scram and switching of all other pumps to reduced speed. To assess a safe cooling situation in the core the interaction between flow reversal in the failed loop and the isolation of that loop by valves is to be taken into account. Consideration of the rupture of one primary pipe involves three aspects of the cooling problem: maintenance of a sufficiently high Na level in the reactor vessel; maintenance of forced or natural convection through the intact loops; and sufficient core cooling during the transient. The three-loop design of the SNR involves the problem of two-loop operation as a matter of economic potential. The emergency cooling conditions in different accident situations are closely linked to the philosophy of safe two-loop operation. The safety potential of natural convection through the Na loops is evaluated. A main concern is the interference of this convection with special operational and accident conditions, and the complexity of the secondary system. The results presented show that loss of power to any pumps, seizure of pumps and the isolation of two loops together or an arbitrary combination of such incidents will, at the most, allow the coolant temperature in hot channels to reach the saturation point for a few seconds. In any incidents with technical credibility the temperature at the core outlet rises only slightly above normal. No breakdown, up to the maximum rupture of a pipe, can initiate a critical loss of sodium if the pump speed is reduced to or below an emergency level. The dissipation of decay heat can be performed by forced or natural convection through the unaffected loops. (auth)

52763 NUCLEAR POWER REACTORS AND MOBILE NUCLEAR INSTALLATIONS. Wiesenack, G. (Technische Ueberwachungsvereine e.V., Essen). VDI (Ver. Deut. Ing.) Z.; 112: 159-66(Feb 1970). (In German).

A survey is presented of the present state and the projects of nuclear power stations around the world (without the Eastern countries), the different reactor types, particularly in the FRG, reactor components and reactor safety. A detailed description of the situation in the FRG is given. The status and the development of nuclear ships are examined. 124 references. (INIS)

52764 REACTOR INSTRUMENTATION. von Haebler, D. (Siemens AG, Erlangen, Ger.). VDI (Ver. Deut. Ing.) Z.; 112: 166-9(Feb 1970). (In German).

The employ of nuclear power plants in a day-night cycle of electricity supply is planned. For this purpose, reactors must operate in the load-following mode within a certain range of power levels. The problem is to control the load of these reactors and can be solved better in nuclear power stations than in fossil power plants because a nuclear reactor responds less slowly than a steam boiler. The structure of the load control loops of nuclear power plants depends on the chosen type of reactor. A short survey of the control loops of the different German nuclear power plants is presented. (INIS)

52765 MONITORING OF DODEWAARD REACTOR CONTROL ROD MOVEMENT. van der Kooi, H. Philips Tech. Rev.; 30: No. 1-2, 32-4(1970). (In German).

A computer (Philips Computer type PR 8000) for monitoring control rod movement according to a given scheme of control rod configuration stored in the computer is described. (INIS)

52766 MEASUREMENTS DODEWAARD NUCLEAR POWER PLANT. Vogel, R. G. (Keuring van Electrotechnische Materialen, N. V., Arnhem, Netherlands). Ingenieur (Utrecht); 82: E135-40(25 Sep 1970). (In Dutch).

Some measurements on the control characteristics and the dynamic behaviour of the Dodewaard nuclear power plant are explained. A short description is given of the main control loops of the power plant. The control characteristics of the pressure regulation and of the water level and feedwater control are given more in detail. Startup control and nuclear power regulation are done manually for this base-load plant, but some criteria for the startup control are mentioned. Plant behaviour is analyzed for normal disturbances in pressure control and in feedwater control; reactor dynamics for pressure disturbances are reviewed more in detail. (auth) (NE)

52767 REVIEW OF THE REACTORPHYSICS EXPERIMENTS DURING START-UP OF THE DODEWAARD REACTOR, REACTIVITIES IN THE CORE, THERMAL-HYDRAULIC ASPECTS EXPERIENCE WITH THE INCORE INSTRUMENTATION. Jongen, E. P. B. (Geneenschappelijke Kernenergiecentrale Nederland N. V., Dodewaard). Ingenieur (Utrecht); 82: E123-34 (25 Sep 1970). (In Dutch).

A brief review is given of the physics startup test program of the Dodewaard nuclear reactor and of the most important results of the reactivity measurements that were executed. In addition several operating experiences are mentioned. At ambient temperature the calculated values of the reactivity of nearly all cores that were built appeared to be too high by about 2% Δk. For the full core loading this discrepancy decreased with increasing reactor temperature and at operating temperature (286°C) the calculated reactivities were in good agreement with the experimental results. (auth) (NE)

52768 W.A.G.R. FUEL-HANDLING EQUIPMENT: DESIGN, OPERATION, AND CONTRIBUTION TO FUTURE DESIGNS. Slater, E. (United Kingdom Atomic Energy Authority, Windscale, Eng.); Packman, G.; Weaden, H. R. Proc. Inst. Mech. Eng. (London); 183: 19-27(1968-69).

From Symposium on Refueling of Gas-Cooled Reactors, London, England. See CONF-681229.

The ability to charge and discharge fuel and other reactor channel components with the reactor on load is a key feature of all U. K. nuclear power stations. The system adopted on the Windscale Advanced Gas-cooled Reactor (W.A.G.R.), where each core channel is provided with its own standpipe (single-channel access), simplified the operation of locating a particular channel; there is no need to insert any moving parts into the reactor circuit, and the critical operation of coupling the fuel to the machine is carried out at ambient temperature with no radiation problems. For five years the W.A.G.R. fuelling machine has demonstrated the ease of fuelling with a single-channel access system, and the integrity and reliability of the equipment is demonstrated by its record, which exceeds 7000 operations. From operating experience on the W.A.G.R. it is clear that changes can be made in the design of fuelling machines and equipment for future commercial stations to improve efficiency and reduce costs. (auth) (UK)

52769 LATINA FUEL-HANDLING EXPERIENCE. Gualtieri, G.; Ascione, G.; Piccioni, E. (Latina Power Station, Rome). Proc. Inst. Mech. Eng. (London); 183: 28-36(1968-69).

From Symposium on Refueling of Gas-Cooled Reactors, London, England. See CONF-681229.

It is stated that the fuel handling system of the Latina power station is based on the same philosophy as that of the U. K. Bradwell station. It comprises three main parts: handling equipment for the new fuel; two charge discharge machines — each on standby to the other — and associated pile-cap equipment; and handling equipment for the irradiated fuel. Details are given of the design philosophy, together with experience in design, erection, commissioning and operation. Some notes are included on the desplittering of spent fuel. The system has, on the whole, been satisfactory in operation. (UK)

52770 FUEL HANDLING AT TRAWSFYNYDD NUCLEAR POWER STATION. Harding, H. W. (Atomic Power Constructions Ltd., Sutton, Eng.). Proc. Inst. Mech. Eng. (London); 183: 37-44(1968-69).

From Symposium on Refueling of Gas-Cooled Reactors, London, England. See CONF-681229.

The fuel-handling route at a Magnox nuclear power station such as Trawsfynydd may be conveniently divided into two parts — the charge face equipment dealing with the fuel and other items into and out of the reactor, and the auxiliary equipment for the discharge and disposal of irradiated items. The complete fuel-handling route is described, but emphasis is on the charge face equipment, which consists principally of two composite fuelling machines for each reactor with some extra items for servicing, and standpipe preparation. The design philosophy is discussed, and the functions of the various parts of the plant described. The design and development experience and the lessons learned are reviewed. (auth) (UK)

52771 FUEL HANDLING AT BERKELEY NUCLEAR POWER STATION. Connor, F. P.; Thomas, T. (Berkeley Nuclear Power Station, Gloucester, Eng.). Proc. Inst. Mech. Eng. (London); 183: 45-55(1968-69).

From Symposium on Refueling of Gas-Cooled Reactors, London, England. See CONF-681229.

Details are given of the charge/discharge machines, the sequence of charge/discharge and chute machine movements, the general features of the system, operation of the system, and future developments. The station is reaching the end of an experimental loading to prove the feasibility of axial fuel shuffling. A charge/discharge machine will shuffle four channels without having to leave a standpipe. (UK)

52772 FUEL HANDLING AT TOKAI-MURA. Bird, R. H.; Saunders, A. S. (GEC-Process Engineering Ltd., Erith, Eng.). Proc. Inst. Mech. Eng. (London); 183: 56-61(1968-69).

From Symposium on Refueling of Gas-Cooled Reactors, London, England. See CONF-681229.

Fuel charging and discharging at the Tokai-Mura nuclear power station is conducted from the top of the reactor, the fuel handling equipment in principle being like that of the U. K. Magnox reactors, although there are important differences. One of the more unusual requirements of the design was that it should be able to withstand severe earthquakes, and a basic requirement was that under the worst foreseeable seismic shock the main pressure circuit must remain intact. A general description of the system is given, together with charge machine erection, testing and maintenance and operational experience. (UK)

52773 FUEL EQUIPMENT FOR HINKLEY POINT B AND HUNTERSTON B. Fortey, J. (Nuclear Power Group Ltd., Knutsford, Eng.); Treliving, N. R.; Cooke, B. F. Proc. Inst. Mech. Eng. (London); 183: 62-8(1968-69).

From Symposium on Refueling of Gas-Cooled Reactors, London, England. See CONF-681229.

The same design of fuel-handling equipment is used for these two stations. On each, a single, gantry-mounted, charge machine is used for both reactors and includes, as far as possible, the features which were developed on earlier gas-cooled reactor stations. The charge machine, although taller, is similar to these earlier machines, but considerably simpler in design, except where additional equipment was added to suit requirements of the A.G.R. fuel assembly. These are described but are under examination to re-assess their necessity. (auth) (UK)

52774 FUEL HANDLING EXPERIENCE AT CALDER HALL. Long, W. H.; Worsnop, W. (United Kingdom Atomic Energy

Authority, Windscale, Eng.). Proc. Inst. Mech. Eng. (London); 183: 69-74(1968-69).

From Symposium on Refueling of Gas-Cooled Reactors, London, England. See CONF-681229.

A considerable amount of fuel handling experience has been gained in the 44 reactor years of operation of Calder Hall. As a result of this experience modifications were made to the fuel handling equipment and techniques developed to allow the length of shut-down periods to be kept to a minimum (these reactors do not employ on-load refuelling). A general description of the fuel handling equipment is given, together with operating experience. The use of thermocoupled fuel is also described, together with minor equipment and in-pile photography and viewing. Modifications under consideration include better introscopes for discharge machines, with the viewing lens adjacent to the machine driver. Consideration is also being given to having charge and discharge machine controls brought to the front of the machine on a pendant control, allowing one man to operate the equipment while observing fuel movement. (UK)

52775 FUEL HANDLING AT HUNTERSTON A. Lindfield, M.; Walker, F. (Hunterston Generating Station, West Kilbride, Scotland). Proc. Inst. Mech. Eng. (London); 183: 75-83(1968-69).

From Symposium on Refueling of Gas-Cooled Reactors, London, England. See CONF-681229.

The Hunterston "A" reactors, unlike all the other British gas-cooled natural uranium reactors, are refueled from underneath the core, using sleeved fuel elements. The fuel element comprises a Magnox canned U bar resting on a Zr alloy support beam of hollow rectangular section inside a graphite sleeve, the ends of the beam engaging slots in the graphite. In addition to 10 fuel elements each reactor channel contains at the lower end a graphite reflector sleeve and a steel support member. The charge/discharge standpipes, 101 in number and of 18 in. bore, each provides access to 36 channels, and the refuelling machine is positioned under any standpipe by means of a turntable; it can move off the turntable into bays for loading and discharge of fuel. There are three charge machines, providing a spare for either reactor. The case for sleeves and bottom charging is discussed, and a detailed description of the fuel handling system is given, together with details of commissioning, operating experience, refuelling rates, fuel element can failures, unique faults and incidents, maintenance experience, and service machine and file cap equipment. Reliable operation at twice design rate is being achieved. There have been no major faults, and no safety hazards have been created. The combination of sleeved elements and bottom refuelling shows advantages outweighing disadvantages. (UK)

52776 FUEL-HANDLING EQUIPMENT FOR DUNGENESS B. Jerkins, E. E. (Fairey Engineering Ltd., Stockport, Eng.). Proc. Inst. Mech. Eng. (London); 133: 91-8(1968-69).

From Symposium on Refueling of Gas-Cooled Reactors, London, England. See CONF-681229.

The fuel-handling system of Dungeness "B," the first commercial advanced gas-cooled reactor, is based on the well-proven concept of single-channel access. This provides individual standpipes for each channel in the core in which fuel elements are connected together to form a composite assembly that can be handled as a single unit by the fuelling machine without any of its components penetrating the pressure envelope below the charge face. A single fuelling machine provides the transportation between both reactors and the fuel services housed in the handling block. Fuel discharged from the reactor is handled in the irradiated fuel disposal facility which is capable of remotely dismantling and rebuilding fuel stringers on a routine basis. The prime object of the equipment design has been to provide single-purpose robust machinery, capable of satisfactory operation for long periods without maintenance. (auth) (UK)

52777 SIZEWELL AND WYLFA. Rawson, P. J. (English Electric Co. Ltd., Stafford, Eng.); Shipman, T. Proc. Inst. Mech. Eng. (London); 183: 99-108(1968-69).

From Symposium on Refueling of Gas-Cooled Reactors, London, England. See CONF-681229.

The fuelling equipment for both these reactor systems was designed on the basis of the following major requirements: that only one machine should be necessary for the actual fuelling operation; that the number of mechanisms on the machine should be reduced to a minimum; a consistent safety and interlock philosophy should be adopted; and that all the normal requirements of on-load refuelling should be met. The fuelling machine and servicing machine are described in detail. Development problems are outlined, and operational details given for the refuelling of gas-cooled reactors. (UK)

52778 BRADWELL, DUNGENESS A, AND OLDBURY. Fortey, J. (Nuclear Power Group, Ltd., Knutsford, Eng.); Vowles, A. F. Proc. Inst. Mech. Eng. (London); 183: 116-23 (1968-69).

From Symposium on Refueling of Gas-Cooled Reactors, London, England. See CONF-681229.

It was considered that for the Bradwell nuclear power plant a single multi-purpose charge machine would suffice for each reactor (although a spare machine was also supplied for each). The machine in use is carried on a gantry to give access to all the operating points. There is no provision for using two machines at the same time. At Dungeness "A," however, owing to the larger reactor and faster handling rate, it was found necessary to use two machines simultaneously. The gantries are also arranged to cover the reactors, but the fuel handling cells are arranged beneath two similar bays; one machine can therefore be used over the reactor while the other is in use in a bay. On account of the "turn round" time and the fact that the duty times of the two machines are of unequal length, the handling rate with two machines is considerably lower than would be expected. At Oldbury the lay-out adopted is virtually two Dungeness "A" machines joined together with a common services block. Details are given of the charge machines and gantry and operating experience. (UK)

52779 HINKLEY POINT A. Atkinson, R. V. (Hinkley Point Nuclear Power Station, Bridgwater, Eng.); Lawson, D. S. Proc. Inst. Mech. Eng. (London); 183: 131-41(1968-69).

From Symposium on Refueling of Gas-Cooled Reactors, London, England. See CONF-681229.

The fuelling scheme adopted for Hinkley Point employs a "hole preparation machine" for inserting a charge chute into the reactor, followed by a separate fuelling machine to operate the charge chute and change the fuel. While the initial machinery was able to change the fuel and remove "bursts" when required its operating rate allowed a backlog of refuelling to build up. The machines have since been successfully developed so that they can refuel at a high rate to remove the backlog without having to refuel off-load. Details are given of the design philosophy, organization of the work, the overall scheme, the charge chute, the "hole" preparation machine, the fuelling machine, development matters, and operating experience. (UK)

52780 STUDY AND DEVELOPMENT OF REACTOR VESSELS FOR THE PHENIX REACTOR AND INTEGRATED CIRCUIT POWER REACTORS. Payan, G. (Societe des Forges et Ateliers du Creusot, Paris); Villeneuve, J.; Sauvage, M.; Lagrange, M.; Andre, J.-P.; Geffroy, B. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 83, 23-31(May-Jun 1970). (In French).

The principle features reviewed are: the general study of the organization of the cooling system and the reactor vessel supports, mechanical studies (vibrations, the effects of earth tremors, maximum credible accidents), and metallurgical and technological studies (electron probe welding, the use of insulation in the reactor vessels and the use of large metallic bellows). (auth) (France)

52781 HYDRAULIC PROBLEMS OCCURING IN SODIUM COOLED FAST REACTORS. Dupont, J.-P. (Societe Grenobloise d'Etudes et d'Applications Hydrauliques, Grenoble, France). Lambert, P.; Leon, P.; (and others). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 83, 46-57(May-Jun 1970). (In French).

The hydraulics of the PHENIX reactor were studied. The problems arising in the construction of the different parts of the reactor were discussed. The various phenomena studied were: the isothermal hydraulics (charge flow and free surface flow) the thermohydraulic (thermal transfer), the fluctuating hydrodynamic forces (resonances between the solid structures and the flow, vibrations), the transient hydraulic region, and cavitation. (auth) (France)

52782 EQUATION SYSTEM FOR THE TRANSIENT ANALYSIS FOR THE LINGEN NUCLEAR POWER PLANT. Reinhardt, Alfred (AEG-Telefunken, Frankfurt am Main). Atomkernenergie; 16: 99-108(1970).

In the course of construction of the Lingen nuclear power plant it was necessary to carry out extensive calculations for a large number of operating states and conceivable malfunctions in order to verify that all the components could reliably fulfil the tasks assigned to them and to prepare the documentation required for the approval of the plant by the competent authorities. The first step in determining the evolution of transient phenomena affecting the entire plant is to describe the plant in terms of equations. The resulting system of equations is so large and difficult to handle that, in order to process it on available computer facilities, it is

unavoidably necessary to replace it by a simplified model. The methods used in setting up the system of equations are described. The organization of such a great problem is shown; a list of equations, a list of variables and constants, a local survey of the variables and a block diagram of the equations, each with some comments, are presented. (6 references) (auth)

52783 NUCLEAR POWER SCHEDULE STRUGGLE. Olds, F. C. Power Eng.; 74: No. 9, 35-41(Sep 1970).

A follow-up examination of the status of U. S. nuclear power plant construction indicates that the rate of slippage has increased since March 1969. Factors influencing the slippage include environmental aspects, siting problems, licensing procedure changes, and increased costs. Plant additions and their projected commercial operation dates are presented. (H.D.R.)

52784 ULTRA-LONG RANGE NUCLEAR FUEL CYCLE. SURVEY STUDY ON THE FUTURE PATTERNS OF NUCLEAR-REACTOR TYPES FOR POWER GENERATION. Iinuma, Takamasa (Science and Tech. Agency, Tokyo). Atomu; 15: No. 2, 14-24(Feb 1970). (In Japanese).

The development of ATR and FBR is proceeding for the purpose of fuel production. Light-water reactor plants are being built for electric power generation. The future patterns of types of nuclear reactors in association with the ultra-long range nuclear fuel cycle are derived. The current speculations on the types of reactors and fuel-material considerations are analyzed. (Japan)

52785 ENERGY REQUIREMENT CALCULATIONS CONSIDERING THE EMPLOY OF NUCLEAR REACTORS. Schulten, R.; Kugeler, K.; Kugeler, M. Energ. Tech.; 22: No. 5, 148-55 (1970). (In German).

A forecast is given about the future energy requirements of the world, until 2000, subdivided into primary sources of energy. The costs of power produced from pit coal, lignite, oil, natural gas, and from boiling water reactors are compared. The different reactor-types including their prospects of development are characterized especially with respect to their capability of generating process steam and high-temperature heat. The chances of developing the power market in the Federal Republic of Germany until 2000 are discussed and the energy consumption is broken down by categories of demand. (INIS)

52786 SPECIAL FEATURES OF MEASURING AND CONTROL SYSTEMS IN NUCLEAR POWER PLANTS. Weidmann, J. (Hartmann und Braun AG, Frankfurt am Main); Ettemeyer, T. Mitt. Ver. Grosskesselbetr.; 50: No. 2, 94-9(Apr 1970). (In German).

After a description of the usual measuring methods as applied in conventional power plants, the special measurements which have to be carried out in nuclear power plants and the requirements for the measuring devices are described. The control systems of plants with different types of reactors are illustrated and compared with conventional systems. The importance of the protection of the reactors is emphasized. (INIS)

Operation and Economics

52787 (AECL-3686) PROSPECT OF VERY LOW COST POWER FROM ONTARIO HYDRO BASED ON LARGE CAPACITY NUCLEAR GENERATING STATIONS. Lewis, W. Bennett (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Aug 1970. 34p. (DM-112). Dep. NTIS (U. S. Sales Only). AECL $1.00.

It is shown how, by the use of heavy-water-moderated nuclear power generating stations and their further development, the cost of power sold could be brought down in less than 50 years of continued expansion, even at as high a rate as 7% per year, from 7.6 mill/kWh in 1968 to the range 6 to 4 mill/kWh in terms of 1968 dollar values. It seems, however, inevitable that the price must first rise in order to effectively eliminate the debt now standing at over $250 per kilowatt of peak capacity on the whole system. It is shown that the future low cost can be reached most quickly by: (1) ceasing to borrow money as soon as possible, which will entail a temporary price rise of 2 to 5 mill/kWh; (2) following a planned program for purchasing equipment that will enable manufacturers and suppliers to learn the necessary techniques while holding no monopoly, nationally or internationally; (3) devoting about 2.5% of revenue or 0.2 mill/kWh to immediate known and specifiable nuclear reactor and steam turbine development; and (4) slowing the rate of committing conventional thermal plant construction and halting future commitments when nuclear generating stations are satisfactorily in operation. (auth)

52788 (DOCKET-1155-80) LA CROSSE BOILING WATER REACTOR. Unplanned Reactor Scram. Incident Report No. DPC-70-18. (Dairyland Power Cooperative, La Crosse, Wis.). 9 Oct 1970. 3p. Dep. NTIS.

52789 (DOCKET-1155-81) LA CROSSE BOILING WATER REACTOR. Unplanned Reactor Scram. Incident Report No. DPC-70-19. (Dairyland Power Cooperative, La Crosse, Wis.). 9 Oct 1970. 2p. Dep. NTIS.

52790 (DOCKET-1155-82) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report, August 1970. (Dairyland Power Cooperative, La Crosse, Wis.). 29 Oct 1970. Contract AT(11-1)-851. 26p. (DPC-851-14). Dep. NTIS.

52791 (DOCKET-50016-83) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Information on Current Status, Plans for Future Operation and Information Related to a Physical Modification. (Power Reactor Development Co., Detroit, Mich.). 23 Oct 1970. 4p. Dep. NTIS.

52792 (DOCKET-50029-136) YANKEE NUCLEAR POWER STATION. Operation Report No. 117, September 1970. (Yankee Atomic Electric Co., Westboro, Mass.). 20 Oct 1970. 7p. Dep. NTIS.

52793 (DOCKET-50155-48) BIG ROCK POINT NUCLEAR PLANT. Failure of Emergency Generator to Operate Properly During Routine Bimonthly Testing. (Consumers Power Co., Jackson, Mich.). 8 Oct 1970. 2p. Dep. CFSTI.

52794 (DOCKET-50155-49) BIG ROCK POINT NUCLEAR PLANT. Addendum to Eighth, Ninth, and Twelfth Semiannual Reports of Operations. (Consumers Power Co., Jackson, Mich.). 9 Oct 1970. 4p. Dep. CFSTI.

52795 (DOCKET-50155-50) BIG ROCK POINT NUCLEAR PLANT. Errata to the Addendum to Eighth, Ninth, and Twelfth Semiannual Reports of Operations. (Consumers Power Co., Jackson, Mich.). 20 Oct 1970. 2p. Dep. NTIS.

52796 (DOCKET-50171-56) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Monthly Operations Report No. 54, August 1970. (Philadelphia Electric Co., Pa.). 19 Oct 1970. 10p. Dep. NTIS.

52797 (DOCKET-50206-92) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Operation Report, September 1970. (Southern California Edison Co., Los Angeles). Oct 1970. Contract AT(30-1)-3270. 6p. (NYO-3270-42). Dep. CFSTI.

52798 (DOCKET-50213-77) CONNECTICUT YANKEE ATOMIC POWER PLANT. Operation Report No. 68-7, July 1968. (Connecticut Yankee Atomic Power Co., Haddam). 13 Aug 1968. Contract AT(30-1)-3250. 10p. (NYO-3250-19). Dep. NTIS.

52799 (DOCKET-50213-78) CONNECTICUT YANKEE ATOMIC POWER PLANT. Operation Report No. 70-9, September 1970. (Connecticut Yankee Atomic Power Co., Haddam). 21 Oct 1970. Contract AT(30-1)-3250. 12p. (NYO-3250-52). Dep. NTIS.

52800 (DOCKET-50219-110) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Turbine Hydraulic and Mechanical Control System Operating Problems. (Jersey Central Power and Light Co., Morristown, N. J.). 8 Oct 1970. 5p. Dep. CFSTI.

52801 (DOCKET-50237-76) DRESDEN NUCLEAR POWER STATION, UNIT 2. Semiannual Report, December 22, 1969-June 30, 1970, Corrections to Gross Electric Power for Month of May 1970. (Commonwealth Edison Co., Chicago, Ill.). 24 Sep 1970. 2p. Dep. CFSTI.

52802 (DOCKET-50237-78) DRESDEN NUCLEAR POWER STATION, UNIT 2. Technical Specifications, Valve Failures on Surveillance Tests. (Commonwealth Edison Co., Chicago, Ill.). 9 Oct 1970. 2p. Dep. CFSTI.

52803 (DOCKET-50244-50) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1. Valve Malfunction While Shut Down. (Rochester Gas and Electric Corp., N. Y.). 5 Oct 1970. 1p. Dep. CFSTI.

52804 (DOCKET-50244-51) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1. Malfunction of Core Deluge Valve. (Rochester Gas and Electric Corp., N. Y.). 14 Oct 1970. 2p. Dep. NTIS.

52805 (DOCKET-50263-48) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Unusual Occurrence Report No. 5.

(Northern States Power Co., Minneapolis, Minn.). 6 Oct 1970. 5p. Dep. CFSTI.

The malfunction of the inlet valve to the A circuit of the standby gas treatment system is described. Necessary repairs are discussed. (D.C.C.)

52806 (DOCKET-50263-49) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Operating Problems. (Northern States Power Co., Minneapolis, Minn.). Sep 1970. 3p. Dep. CFSTI.

52807 (DOCKET-50263-50) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Fifth Standby Gas Treatment System Operating Events or Condition. (Northern States Power Co., Minneapolis, Minn.). 12 Oct 1970. 1p. Dep. NTIS.

52808 (FN-E-109) PROGRAM OF RESEARCH COMPLETED AT THE E. FERMI FACILITY. Progress Report No. 10, January–March 1969. (FIAT, Turin (Italy). Sezione Energia Nucleare). Contract 098-66-6-TEEI. 21p. (In Italian). Dep. CFSTI (U. S. Sales Only).

The quarter's activity was devoted principally to testing the new monodimensional burnup code SQUIRREL and to calculations with the SQUID code in bidimensional geometry. The results of the burnup calculations made with the SQUIRREL code for the core of Trino Vercellese reactor are presented. The axial power distributions obtained were compared with the results obtained previously using the MELE code and the Aeroball profile. Also the radial distribution of the short-lived activations was calculated with the SQUID code and compared with the experimental data. (tr-auth)

52809 (GA-10300) 40-MW(e) PROTOTYPE HIGH-TEMPERATURE GAS-COOLED REACTOR POSTCONSTRUCTION RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending July 31, 1970. (Gulf General Atomic, Inc., San Diego, Calif.). 31 Aug 1970. Contract AT(04-3)-314. 28p. Dep. CFSTI.

NEUTRONS, FAST—effects on fracture toughness of pressure vessel steels, (E)
PEACH BOTTOM POWER REACTOR, UNIT 1—fission product concentrations in, diffusion probe plateout measurements of
—operation during May to August 1970
—physics measurements on Core 2, subcritical loading and zero power
—reactivity helium flow coefficient for Core 2, (E)
—reactivity temperature coefficient for Core 2, (E/T)
—pressure vessel for, fast neutron effects on fracture toughness of, (E)
—fission product release monitoring in cooling and fuel element purge systems following Core 2 startup
STEEL—radiation effects on fracture toughness of pressure vessel, fast neutron, (E)

52810 START-UP NUCLEAR POWER STATION DODEWAARD. Woldringh, S. H. (Gemeenschappelijke Kernenergiecentrale Nederland N. V., Dodewaard). Ingenieur (Utrecht); 82: E117-22(25 Sep 1970). (In Dutch).

A review is given of the start-up and the following operation of the first nuclear power station in The Netherlands. After arrival of the reactor vessel on site (January 4, 1968), the reactor went critical for the first time on June 24. The generator was synchronized with the grid for the first time on October 25 and the SEP-test terminated on December 29, 1968. The only serious problems encountered were due to insufficient dewatering of the turbine. The availability factor of the nuclear steam supply system was 99.99% for the year 1969. The fuel elements appeared to be of excellent quality. (auth) (NE)

Safety and Siting

52811 (DOCKET-50003-56) INDIAN POINT STATION, UNIT NO. 1. Comments on Uniform Monitoring, Recording and Reporting Guide. (Consolidated Edison Co. of New York, Inc., New York). 19 Oct 1970. 2p. Dep. NTIS.

52812 (DOCKET-50010-69) DRESDEN NUCLEAR POWER STATION, UNIT 1. Further Information on the Furnace Sensitized Stainless Steel Parts. (Commonwealth Edison Co., Chicago, Ill.). 22 Oct 1970. 6p. Dep. NTIS.

52813 (DOCKET-50016-82) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Amended Request for Authorization of Change No. 23 in the Technical Specifications. (Power Reactor Development Co., Detroit, Mich.). 20 Oct 1970. 13p. Dep. NTIS.

Revised reactor power level restrictions for operations with reusable core-A fuel subassemblies are presented. (D.C.C.)

52814 (DOCKET-50029-132) YANKEE NUCLEAR POWER STATION. License No. DPR-3; Technical Specifications Change No. 92. (Division of Reactor Licensing (AEC), Washington, D. C.). 2 Oct 1970. 1p. Dep. CFSTI.

Design modifications are presented for replacing 5.25 inch diameter reactor vessel closure studs with 4.75 inch diameter studs. (D.C.C.)

52815 (DOCKET-50029-133) YANKEE NUCLEAR POWER STATION. License No. DPR-3; Technical Specifications Proposed Change No. 91, Suppl. 1. (Yankee Atomic Electric Co., Westboro, Mass.). 9 Oct 1970. 4p. Dep. CFSTI.

Pre-operational check-out program for each diesel generator unit is described. (D.C.C.)

52816 (DOCKET-50029-134) YANKEE NUCLEAR POWER STATION. License No. DPR-3; Technical Specifications Proposed Change No. 95, Suppl. 2. (Yankee Atomic Electric Co., Westboro, Mass.). 9 Oct 1970. 5p. Dep. CFSTI.

Design modifications for the coolant recirculation system are described. (D.C.C.)

52817 (DOCKET-50029-135) YANKEE NUCLEAR POWER STATION. License No. DPR-3; Technical Specifications Change No. 94. (Division of Reactor Licensing (AEC), Washington, D. C.). 22 Oct 1970. 1p. Dep. NTIS.

Permission to operate the reactor with the fuel loading configuration of Core 9 is presented. (D.C.C.)

52818 (DOCKET-50133-38) HUMBOLDT BAY POWER PLANT, UNIT NO. 3. Comments on Proposed Guide on Uniform Monitoring, Recording and Reporting Guide. (Pacific Gas and Electric Co., San Francisco, Calif.). 12 Oct 1970. 9p. Dep. NTIS.

52819 (DOCKET-50133-39) HUMBOLDT BAY POWER PLANT, UNIT NO. 3. Reply to Request for Information on Sensitized Stainless Steel Components. (Pacific Gas and Electric Co., San Francisco, Calif.). 14 Oct 1970. 7p. Dep. NTIS.

52820 (DOCKET-50133-40) HUMBOLDT BAY POWER PLANT, UNIT NO. 3. License No. DPR-7; Addendum A to Technical Specifications Proposed Change No. 27. (Pacific Gas and Electric Co., San Francisco, Calif.). 20 Oct 1970. 3p. Dep. NTIS.

Modification of the control rod withdrawal time limit is presented. (D.C.C.)

52821 (DOCKET-50146-62) SAXTON REACTOR. Proposed Construction of Lake Raystown. (Corps of Engineers, Baltimore, Md.). 12 Oct 1970. 3p. Dep. NTIS.

52822 (DOCKET-50146-63) SAXTON REACTOR. License No. DPR-4; Technical Specifications Change No. 39. (Division of Reactor Licensing (AEC), Washington, D. C.). 21 Oct 1970. 2p. Dep. NTIS.

Technical specifications are modified to include two test engineers instead of only one test engineer. (D.C.C.)

52823 (DOCKET-50171-57) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Comments on Uniform Monitoring, Recording and Reporting Guide. (Philadelphia Electric Co., Pa.). 19 Oct 1970. 5p. Dep. NTIS.

52824 (DOCKET-50213-76) CONNECTICUT YANKEE ATOMIC POWER PLANT. Sensitized Stainless Steel Components Within the Reactor Coolant System. (Connecticut Yankee Atomic Power Co., Westboro, Mass.). 29 Sep 1970. 9p. Dep. CFSTI.

52825 (DOCKET-50219-111) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Provisional Operating License DPR-16; Technical Specifications Change Request No. 2, Suppl. 2. (Jersey Central Power and Light Co., Morristown, N. J.). 13 Oct 1970. 5p. Dep. CFSTI.

Modifications in safety instrumentation positions and trip levels are described. (D.C.C.)

52826 (DOCKET-50219-112) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Technical Specifications Change No. 4. (Division of Reactor Licensing (AEC), Washington, D. C.). 16 Oct 1970. 3p. Dep. NTIS.

Modifications of operation specifications to allow deactivation of the containment spray system and drywell pressure instrumentation during integrated primary containment leak rate testing are described. (D.C.C.)

52827 (DOCKET-50220-49) NINE MILE POINT NUCLEAR STATION. Technical Supplement to Petition to Increase Power Level, First Addendum. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 12 Oct 1970. 40p. Dep. CFSTI.

52828 (DOCKET-50237-77) DRESDEN NUCLEAR POWER STATION, UNIT 2. , Technical Specification, Two Control Rod Drives with Excessive Scram Times. (Commonwealth Edison Co., Chicago, Ill.). 25 Sep 1970. 2p. Dep. CFSTI.

52829 (DOCKET-50237-79) DRESDEN NUCLEAR POWER STATION, UNIT 2. Modifications to Proposed Change No. 6. (Commonwealth Edison Co., Chicago, Ill.). 13 Oct 1970. 2p. Dep. CFSTI.

Revised and additional information is presented concerning inspection requirements for furnace sensitized stainless steel components in the reactor. (D.C.C.)

52830 (DOCKET-50237-80) DRESDEN NUCLEAR POWER STATION, UNIT 2. Procedure and Safety Evaluation for Sectioning of Fuel Rods. (Commonwealth Edison Co., Chicago, Ill.). 19 Oct 1970. 9p. Dep. NTIS.

52831 (DOCKET-50255-29) PALISADES PLANT. Environmental Report, Operating License Stage. (Consumers Power Co., Jackson, Mich.). 9 Oct 1970. 80p. Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

52832 (DOCKET-50271-33) VERMONT YANKEE NUCLEAR POWER STATION. Order Amending Provisional Construction Permit. (Division of Reactor Licensing (AEC), Washington, D. C.). 27 Oct 1970. 4p. Dep. NTIS.

52833 (DOCKET-50282-25) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Facility Description and Safety Analysis Report, Supplementary Information. (Northern States Power Co., Minneapolis, Minn.). 16 Oct 1970. 11p. (DOCKET-50306-25). Dep. NTIS.

Revised information on the classifications of structures systems, and components is presented. (D.C.C.)

52834 (DOCKET-50289-27) THREE MILE ISLAND NUCLEAR STATION, UNITS 1 AND 2. Environmental Report. (Metropolitan Edison Co., Reading, Pa.). 1 Sep 1970. 91p. (DOCKET-50320-18). Dep. CFSTI.

52835 (DOCKET-50289-28) THREE MILE ISLAND NUCLEAR STATION, UNIT 1 AND UNIT 2. Environmental Report: Operating License Stage, Erratum. (Metropolitan Edison Co., Reading, Pa.). 7 Oct 1970. 2p. (DOCKET-50320-19). Dep. CFSTI.

52836 (DOCKET-50293-31) PILGRIM NUCLEAR POWER STATION. [Preliminary Safety Analysis Report], Amendment 16. (Boston Edison Co., Mass.). 2 Oct 1970. 189p. Dep. CFSTI.

52837 (DOCKET-50293-32) PILGRIM NUCLEAR POWER STATION. Reactor Pressure Vessel Design Report. Preliminary Safety Analysis Report, Amendment 17. (Boston Edison Co., Mass.). 9 Oct 1970. 183p. Dep. NTIS.

52838 (DOCKET-50313-25) ARKANSAS NUCLEAR ONE. Preliminary Safety Analysis Report, [Amendment 19], Suppl. 19, Additional Information. (Arkansas Power and Light Co., Little Rock). 12 Oct 1970. 4p. Dep. CFSTI.

Additional information is presented on the reinforcing construction of the concrete containment structure. (D.C.C.)

52839 (DOCKET-50336-20) MILLSTONE NUCLEAR POWER STATION, UNIT 2. Preoperational Environmental Radiation Survey Program. Semiannual Report, October 1, 1969-June 30, 1970. (ICN/Tracerlab, Waltham, Mass.). 22 Sep 1970. 55p. Dep. CFSTI.

For Millstone Point Co., Wethersfield, Conn.

52840 (DOCKET-50338-24) NORTH ANNA POWER STATION, UNITS 1 AND 2. Safety Evaluation. (Division of Reactor Licensing (AEC), Washington, D. C.). 14 Oct 1970. 124p. (DOCKET-50339-23). Dep. NTIS.

For Virginia Electric and Power Co., Richmond.

52841 (DOCKET-50344-15) TROJAN NUCLEAR PLANT. Preliminary Safety Analysis Report, Amendment 10. (Portland General Electric Co., Oreg.). 12 Oct 1970. 2p. Dep. CFSTI.

Additional information concerning the containment structure configuration is presented. (D.C.C.)

52842 (DOCKET-50344-16) TROJAN NUCLEAR PLANT. Amendment No. 2 to the Application for License. (Portland General Electric Co., Oreg.). 9 Oct 1970. 118p. Dep. CFSTI.

Financial data on the owners of the Trojan Power Reactor Unit 1 are given in support of the application for construction permit. The 1969 Annual Reports for the Portland General Electric Company, Pacific Power and Light Company, and the Eugene Water and Electric Board are included. (D.C.C.)

52843 (DOCKET-50344-17) TROJAN NUCLEAR PLANT. Amendment No. 3 to the Application for License. (Portland General Electric Co., Oreg.). 9 Oct 1970. 4p. Dep. NTIS.

52844 (DOCKET-50367-8) BAILLY GENERATING STATION, NUCLEAR 1. Preliminary Safety Analysis Report, Amendment 1. (Northern Indiana Public Service Co., Hammond). 16 Oct 1970. 6p. Dep. NTIS.

Revised and additional information is presented concerning construction costs and insurance coverage. (D.C.C.)

52845 (DOCKET-50368-5) ARKANSAS NUCLEAR ONE, UNIT 2. Applicant's Environmental Report, Construction Permit Stage. (Arkansas Power and Light Co., Little Rock). 17 Oct 1970. 112p. Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

52846 RADIATION PROTECTION IN THE RHEINSBERG NUCLEAR POWER PLANT. Gerullis, W.; Krueger, F. W.; Michaelis, U. E. (VEB Kombinat Kraftwerksanlagenbau, Berlin). Kernenergie; 13: 209-26(Jul 1970). (In German).

The Rheinsberg nuclear power plant was started on the 9th of May, 1966. It includes a pressurized-water reactor of 265 MW designed thermal power. Extensive protection provisions have been taken against the dangers in handling radioactive substances and sources of ionizing radiation in the Rheinsberg nuclear power plant. They include site selection, construction of the containment, decontamination of waste waters and exhaust air, construction of radiation shields, dosimetric and sanitary arrangements. The protection provisions taken in the Rheinsberg nuclear power plant are described. The designed parameters are given. 12 references. (auth)

52847 INVESTIGATION OF NUCLIDE CONCENTRATION IN REACTOR WATER AND WASTE WATER. Ruf, M.; Huebel, K. (Bayerische Biologische Versuchsanstalt, Munich). Z. Wasser-Abwasserforsch.; 3: No. 2, 38-9(1970). (In German).

Using beta and γ spectrometric as well as radiochemical methods, the qualitative and quantitative nuclide content of mixed samples of the primary cooling water and waste water of the 237 MW(e) nuclear power plant at Gundremmingen were studied. From March to December 1969, the long-lived activity was caused especially by the fission products ^{131}I, ^{140}Ba, ^{137}Cs, ^{89}Sr, ^{90}Sr, and T. The activation activity was above all due to ^{58}Co, ^{60}Co, and ^{54}Mn. (INIS)

52848 DATA ACQUISITION SYSTEM FOR THE DETERMINATION OF RELIABILITY MAGNITUDES. Schlothauer, D. (Technische Ueberwachungsvereine eV, Cologne). Tech. Ueberwach.; 11: 79-82(1970). (In German).

Reliability analyses are a new possibility for safety considerations. For this purpose reliable data concerning the rate of failure of construction elements, which can be obtained by an assessment of these elements and the damage occurring, are required. With the purpose of building a data bank, a data sheet for construction elements and a special form for damage assessment are described. (INIS)

52849 UNIFIED ACQUISITION OF FAILURES: THE BASE OF RELIABILITY ANALYSES. Vetter, H. (Rheinisch-Westfaelisches Elektrizitaetswerk, Essen). Tech. Ueberwach.; 11: 75-8(1970). (In German).

For a considerable period of time the failures occurring in fossil and nuclear power plants have been statistically collected in the RWE so that they are available for evaluation. A part of the failure statistics can also be used for safety considerations. Nevertheless the conclusions thus obtained are not statistically reliable enough for the safety of nuclear power plants. Since it is feared that the expense for adequate failure statistics will be considerable the scope of the work shall be studied in cooperation between the RWE and the IRS at the model of one single block. (INIS)

Power Reactor Development

Refer also to abstract 52981.

52850 (ANL-7737) REACTOR DEVELOPMENT PROGRAM. Progress Report, August 1970. (Argonne National Lab., Ill.). 29 Sep 1970. Contract W-31-109-eng-38. 185p. Dep. CFSTI.

Highlights of project activities for August 1970 are summarized. LMFBR physics development and component development are reviewed. Operations and analysis of ZPR-3, ZPR-6, ZPR-9, and ZPPR are described. The EBR-2 research and development projects, fuel fabrication, and operations are summarized. Reactor fuels and materials development, physics studies, engineering development, fuel cycle chemistry, and LMFBR safety studies are reported. (D.C.C.)

52851 (DP-Report-225) DRAGON PROJECT HELIUM LEAK TESTING. Project DRAGON. Wade, P. (Atomic Energy Establishment, Winfrith (England)). Oct 1963. 30p. (CONF-631012-13). Dep. NTIS.

From Dragon Project Engineering Symposium, Bournemouth, Eng.

Information on the many aspects and principles of He leak testing by He sensitive mass spectrometers is presented. Results of leak tests made at manufacturers and at the reactor site are given together with the necessary precautions that must be observed if the results obtained are to be relied on. (auth)

52852 (GA-9400(Vol.1)) HTGR BASE PROGRAM: TASK I FY-69 DESIGN STUDIES FOR 1000 MW(e) HTGR POWER STATION. VOLUME I. INTRODUCTION AND BASE-CASE PLANT DESCRIPTION. (Gulf General Atomic, Inc., San Diego, Calif.). 30 Jun 1969. Contract AT(04-3)-167. 202p. Dep. CFSTI.

Design parameters and development programs for a 1000 MW(e) HTGR are presented under the following headings: site conditions; reactor core and fuel elements; refueling system; thermal cycle; prestressed concrete pressure vessel; primary cooling system; and plant layout. (D.C.C.)

52853 (RT/GEN-(70)1) SEVERAL TECHNIQUES FOR PROGRAMMING WORK, CASACCIA, 1967. Vol. III. De Iaco, L.; Franco, G.; Merelli, A.; Musso, B. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 21 Dec 1969. 68p. (In Italian). Dep. CFSTI (U. S. Sales Only).

The last lessons of the course on PERT and on other work planning and scheduling techniques carried out at Nuclear Research Centre of Casaccia in 1967 are presented. PERT-COST, CPM and contemporaneous works programming are briefly described. The volume ends with a lesson devoted to PERT application to the construction of high temperature reactor "DRAGON." (auth)

52854 (STI/PUB-256) SODIUM-COOLED FAST REACTOR ENGINEERING. Proceedings Series. Proceedings of a Symposium Held in Monaco, 23-27 March 1970. (International Atomic Energy Agency, Vienna (Austria)). Jul 1970. 970p. (In several languages). (CONF-700307). IAEA $25.00.

Topics related to the development of liquid metal-cooled fast reactors are discussed. Separate abstracts are included for 46 of the 52 papers presented. Six papers have been previously abstracted and can be found in the NSA Report Number Index under CONF-700307. (D.C.C.)

For abstracts of individual papers see: 52750-52762, 52862, 52891-52908, 52917-52920, 52931-52934, 52954, 52955, and 52965-52968.

52855 PROGRESS WITH WATER-COOLED REACTORS. I. PRESSURIZED WATER REACTORS. Keller, W. (Siemens AG, Erlangen, Ger.). Atomwirt., Atomtech.; 15: 469-72(Sep-Oct 1970). (In German).

To remain competitive with conventional power plants, nuclear stations must aim at simplification, standardization, and increased power. With respect to pressurized water reactors, this development poses problems of which the following aspects are discussed: development of pressurized containers, primary circuits, fuel elements, operation-accessibility-inspection, control concepts, safety measures, release of radioactive material, and prevention of accidents. The analysis shows that pressurized water reactors with a power of 2,000 MW(e) are feasible and will remain, because of their low production cost, competitive even with fast breeder reactors expected to become operational after 1980. (H.B.G.)

52856 PROBLEMS AND TRENDS IN THE CONSTRUCTION OF NUCLEAR POWER STATIONS. Jaeger, T. A. (Bundesanstalt fuer Materialpruefung, Berlin). Mitt. Ver. Grosskesselbetr.; 50: 10-21(Feb 1970). (In German).

The problems and trends of the design and the construction of concrete shields, prestressed-concrete reactor pressure vessels, and reactor containment are discussed. 24 references. (INIS)

52857 GAS COOLING IN NUCLEAR REACTORS. Ehlers, K.; Schroeder, E.; Weicht, U. (Brown Boveri/Krupp Reaktorbau GmbH, Mannheim, Ger.). Atomwirt., Atomtech.; 15: 476-80 (Sep-Oct 1970). (In German).

Development of gas-cooled graphite moderated reactors led from the now obsolete natural uranium-CO_2 type to the advanced gas-cooled CO_2 reactor that achieved economic feasibility in Great Britain; however, its potential for further development is exhausted. Conversely, high developmental potential resides in the high-temperature reactor with helium cooling. With increased temperatures of fuel elements and coolant, turbines can be operated in the direct circuit and valuable process heat can be obtained. Various types of gas-cooled reactors are discussed with respect to technical and economic possibilities, problems, and differences. (tr-auth)

52858 PROGRESS WITH WATER-COOLED REACTORS. 2. BOILING WATER REACTORS. Kornbichler, H. (AEG-Telefunken, Frankfurt am Main). Atomwirt., Atomtech.; 15: 473-6 (Sep-Oct 1970). (In German).

During 1969, development of boiling water reactors was characterized by both augmentation of their position with respect to other reactor types and by increased competition with conventional power stations. Although technical development was primarily aimed at maintaining and securing the present position, a few improvements were introduced. These improvements prominently concerned simplification of the cooling circuit, introduction of a new system for rapid shutdown, and increased standardization of components. (tr-auth)

Kinetics and Dynamics

52859 ANALYTICAL MODEL FOR THE INVESTIGATION OF THE DYNAMIC BEHAVIOR OF A PRESSURIZED WATER REACTOR WITH SELF-PRESSURIZATION. Jaschek, H.; Neuenhahn, P. (Technische Univ., Munich). Atomkernenergie; 16: 109-12 (1970). (In German).

52860 DETERMINATION OF THE FREQUENCY RESPONSE BY MEANS OF NOISE MEASUREMENTS ON A RESEARCH REACTOR. Basti, W. (Technische Hochschule, Munich. Laboratorium fuer Reaktorregelung und Anlagensicherung, Garching, Ger.). Atomkernenergie; 16: 123-8(1970). (In German).

The determination of the frequency response of a reactor with boiling coolant and moderator can be performed by means of noise analysis when assuming the boiling noise as the dominant exciting source. This is shown by the results gained with a theoretical model and with experiments on a research reactor. 16 references. (auth)

Control Systems

52861 (DP-Report-231) REACTOR CONTROL AND INSTRUMENTATION. Project DRAGON. Watts, C. (Atomic Energy Establishment, Winfrith (England)). Oct 1963. 37p. (CONF-631012-14). Dep. NTIS.

From Dragon Project Engineering Symposium, Bournemouth, Eng.

A complete description of the installed control instrumentation of the Dragon reactor is presented. (auth)

52862 THERMOSTAT FOR A FAST REACTOR ASSEMBLY. Egleme, M. (BelgoNucleaire SA, Brussels); Michel, A.; Milinovic, A. pp 283-96 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970). (In French).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

As the conditions of power generation in the blanket of a fast reactor are highly variable with time, the use of a thermostat is very attractive from both an economic and an engineering point of view. In order to be of practical use, this device must be an integral part of the fuel assembly and regulate the flow across the assembly autonomously, without any connection to the outside. The thermostat, as designed at present, does not exceed a length of 200 mm and allows the variation of the outlet temperature with time to be reduced approximately to 30°C. The mechanism is described, and the results of a number of hydraulic and mechanical trails carried out on the first prototypes over the last two years are presented. 4 references. (auth)

52863 SPECIAL PURPOSE DIGITAL COMPUTER DICOR FOR REACTOR CONTROL AND SAFETY SYSTEM. Kovanic, Pavel; Rygl, Jaroslav (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ.; 16: 329-32(Oct 1970). (In Czech).

A brief description of the algorithm, hardware structure and main parameters is given. Three simple independent special purpose computers realize all control and safety functions having been performed as a rule only by well-known facilities composed by many individual measuring, signaling and control channels of analog types. The system of three computers treating pulse signals from fixed fission chambers at source levels can be used at higher neutron flux level than the movable detectors system. In this way, wide-range operation is warranted without any change in the system structure. Simple selfchecking circuits are provided for the whole operational range, as the main idea is the follow-up principle. (auth)

52864 INVESTIGATION OF VARIOUS CONTROL CONCEPTS FOR PRESSURIZED WATER REACTORS WITH SELF-PRESSURIZATION. Jaschek, H.; Merz, L.; Neuenhahn, P. (Technische Univ., Munich). Atomkernenergie; 16: 113-18(1970). (In German).

The dynamic behavior of a pressurized water reactor with self-pressurization is simulated and studied by means of an analytical model. Control concepts are developed and the dynamic behavior of the controlled plant is demonstrated. The comparative discussion of various reactor control concepts shows the efficiency of the fixed setpoint control concepts as compared to the more complex cascade concepts. (12 references) (auth)

52865 NEUTRON TRANSMISSION PROBABILITIES ACROSS CONTROL BLADES FILLED WITH ROUND TUBES: FORMULATION AND ACCURACY. Michelini, M. (CNEN, Rome). Nucl. Sci. Eng.; 42: 162-70(Nov 1970).

Adequate knowledge of the transmission probabilities of neutrons through control blades filled with round tubes containing absorbing material is required in reactor design. Starting from a strict formulation of the problem, some computational approximations are introduced which lead to compact expressions directly available to the designer. The accuracy of the proposed formulas is then investigated in conjunction with a theoretical and numerical analysis of the confidence limit of the most advanced method (P1 blackness theory) of accounting for control blades in diffusion calculations. Finally, comparisons with experimental integral data (Rossi-α measurements) confirm that the accuracy of the proposed formulas is consistent with the precision of the method. (auth)

Cooling Systems

Refer also to abstracts 50641, 50642, 52753, and 52756.

52866 (ANL-7685) PROCEEDINGS OF THE CONFERENCE ON FLOW-INDUCED VIBRATIONS IN REACTOR SYSTEM COMPONENTS, MAY 14-15, 1970. (Argonne National Lab., Ill.). 350p. (CONF-700535). Dep. CFSTI.

Papers assessing the state-of-the-art of techniques for the analysis of coolant-flow-induced vibrations of fuel elements, fuel assemblies, control elements, and cooling system components are presented. A separate abstract was prepared for each of the 18 papers. (H.D.R.)

For abstracts of individual papers see: 52741, and 52867-52883.

52867 (ANL-7685, pp 5-31) RESPONSE OF A FLEXIBLE ROD TO NEAR-FIELD FLOW NOISE. Chen, S. S.; Wambsganss, M. W. (Argonne National Lab., Ill.).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14-15, 1970.

An analytical solution is obtained for the displacement statistics of a simply-supported rod in parallel flow. The system is described by Paidoussis' equation of motion and the mathematical model for the turbulent-boundary-layer pressure statistics is based on a phenomenological model developed by Corcos. The derived model is successful in predicting the basic trends and essential features of parallel-flow-induced vibration. Numerical examples are given for comparison with the experimental measurements and the reasons for the differences between the theoretical prediction and experiment result are discussed. A parameter study is also made for the ranges associated with typical reactor components. The study shows theoretical prediction and experimental correlations to be in good agreement. (21 references) (auth)

52868 (ANL-7685, pp 32-46) EXPERIMENTAL DETERMINATION AND ANALYSIS OF VIBRATIONS INDUCED BY THE NEAR-FIELD FLOW NOISE IN TUBES. Addae, Andrews K. (Massachusetts Inst. of Tech., Cambridge); Fenech, Henri (California Univ., Santa Barbara).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14-15, 1970.

Boundary layer turbulence as a source of excitation in single phase parallel coolant flow as well as the near field and acoustic field components of this flow noise are considered. The mid-span response of a tube excited by the near-field component of boundary layer turbulence is determined experimentally. Results show that only the fundamental mode of the tube is excited. The RMS response predicted by the boundary layer turbulence wall pressure correlation is found to be of the same order of magnitude as the measured RMS response. However, the maximum amplitude predicted by Paidoussis' empirical correlation is a factor of 4 to 15 times greater than the measured RMS response. The near field component of boundary layer turbulence thus appears not to be very important under conditions in which its empirical correlation has been found to apply. (24 references) (auth)

52869 (ANL-7685, pp 47-63) CALCULATION OF THE RESPONSE OF RODS TO BOUNDARY LAYER PRESSURE FLUCTUATIONS. Kanazawa, R. M. (General Electric Co., San Jose, Calif. Nuclear Energy Div.); Boresi, A. P. (Illinois Univ., Urbana).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14-15, 1970.

A method for calculating the probable response of a rod to pressure fluctuations on its surface is shown in detail. The random pressure field which acts on the surface of the rod is assumed to be similar to the pressure fields which have been measured on flat plates in wind tunnels. The mathematical model for a rod in parallel flow which is used in the calculations is based on Bernoulli-Euler beam theory and includes viscous damping. The results are presented in a series of figures which expose the influence of various parameters on the rod response. (11 references) (auth)

52870 (ANL-7685, pp 64-90) DYNAMIC RESPONSE OF SLENDER TUBES IN PARALLEL FLOW WHEN SUBJECTED TO TIME VARYING BOUNDARY CONDITIONS. Knudson, S. A. (Esso Research and Engineering Co., Florham Park, N. J.); Smith, G. M. (Nebraska Univ., Lincoln).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14-15, 1970.

Structural support excitation of reactor components may result from various sources such as pumps, earth tremors, etc. The dynamic response characteristics of slender tubes in parallel flow with induced motion of the tube support structure have been investigated. The results from experimental tests of clamped-free and clamped-pinned tubes are analyzed in terms of flow velocity and level of support excitation. Theoretical studies of several damping models reveal that the response, of support excited tubes in parallel flow, corresponds quite closely to a viscous type damping model. (auth)

52871 (ANL-7685, pp 91-111) UNSTEADY MOMENTUM FLUXES IN TWO-PHASE FLOW AND THE VIBRATION OF NUCLEAR SYSTEM COMPONENTS. Yih, T. S. (Stone and Webster Engineering Corp., Boston, Mass.); Griffith, P. (Massachusetts Inst. of Tech., Cambridge).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14-15, 1970.

The steady and unsteady components of the momentum flux in a two-phase flow have been measured at the exit of a vertical pipe. Measured momentum-flux data have been machine processed by standard random-vibration techniques to obtain the power spectral density curves. From these curves, the predominant frequency and the rms value of the unsteady momentum flux have been obtained. The effects of the average flow velocity, volumetric quality, system pressure, flow-channel size, and geometry on the unsteady momentum fluxes have been observed. It has been found that the fluctuation of momentum fluxes is important only in the low-frequency range. The maximum values of unsteady momentum fluxes appeared in either the high void slug flow or the low void annular flow regime. The experimental results have been correlated and suggestions have been made for constructing the power spectral density curve of momentum fluxes under untested conditions. In the sample problem, using the experimental results, the effect of the unsteady momentum flux on a steam generator U-tube has been studied. (16 references) (auth)

52872 (ANL-7685, pp 112-40) MEASUREMENT, INTERPRETATION, AND CHARACTERIZATION OF NEAR-FIELD FLOW NOISE. Wambsganss, M. W.; Zaleski, P. L. (Argonne National Lab., Ill.).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14-15, 1970.

The nearfield component of flow noise has been identified in

earlier studies as a primary excitation source in the parallel-flow-induced vibration of flexible rods and its measurement and characterization as the cruxes of the problem. An experimental study of the flow noise on the surface of a test element in annular water flow is described. Three, longitudinally in-line, pairs of miniature pressure transducers were constructed on the surface of a tubular test element. The instrumented test element was concentrically mounted within a test section which is part of a water flow loop. This assembly was used to obtain pressure-time measurements of the flow noise. The nearfield mean-square-value spectral densities and rms pressure coefficients were computed from a pressure-difference signal using subtraction process, with a diametrically opposite transducer pair, to null out the far-field noise. Normalization of the mean-square-value spectra is discussed. Convection velocity ratios, mean eddy lifetimes, and correlation lengths are computed from broad-band, longitudinal, space-time correlations. In general, the results are in agreement with those from independent studies of the statistics of wall-pressure fluctuations in pipe flows and flow over flat plates. The low-frequency behavior of the nearfield mean-square-value spectra is believed to represent new data. (21 references) (auth)

52873 (ANL-7685, pp 141-76) CONDUCTIVITY CELLS FOR FLOW INDUCED VIBRATION MEASUREMENTS. Sawtelle, G. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14–15, 1970.

The development of a conductivity cell instrumentation for measuring flow induced vibrations in long, slender fuel pins is described. The design, construction and evaluation of conductivity cells and associated signal conditioning equipment are discussed in detail, providing the background for the underlying theory, operating procedure and limitations of a particular instrument, the PNL Impedance Detector. (11 references) (auth)

52874 (ANL-7685, pp 177-204) APPLICATION OF NOISE ANALYSIS TECHNIQUES TO STUDY OF FLOW INDUCED VIBRATION IN REACTOR SYSTEM COMPONENTS. Randall, R. L. (Atomic International, Canoga Park, Calif.).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14–15, 1970.

Instrumentation and analysis techniques are described for detecting and studying flow induced resonant mechanical vibrations of tubes in an intermediate heat exchanger, using accelerometers attached to the outer wall of the heat exchanger vessel. Techniques for studying flow distribution and flow induced vibration in hydraulic models of reactor core assemblies are also discussed along with a summary of recent applications to flow measurements in 1200°F sodium. (13 references) (auth)

52875 (ANL-7685, pp 205-24) AN ENGINEERING APPROACH TO TUBE FLOW-INDUCED VIBRATIONS. Gerlach, C. R.; Dodge, F. T. (Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14–15, 1970.

A critical review of existing open literature for flow-induced vibrations is presented. It is pointed out to what extent this information may and may not be applied to heat exchangers for the cross-flow situation. Particular attention is given to the critique of available vortex force data, the form it is presently in, and the influence of tube vibration amplitude. A fresh approach to the heat exchanger tube problem is presented, drawing heavily on experience gained in the study of flow-induced vibrations of other types of structures. This new approach will emphasize the design aspects of the problem, and will aim at the development of a method for the prediction of critical area stress levels and vibration amplitudes of tubes in heat exchangers. This new approach is based on the use of an effective vortex force coefficient which conveniently eliminates the need for describing vortex force in terms of an amplitude and a phase angle relative tube motion. Available data are used to show preliminary values of the effective vortex force coefficient which is argued to be a function of only the tube stiffness and size, system damping, and fluid velocity and density. (14 references) (auth)

52876 (ANL-7685, pp 225-47) LIFT AND STROUHAL FREQUENCY FOR BLUFF SHAPES IN CONSTRICTED PASSAGES. Toebes, G. H.; Ramamurthy, A. S. (Purdue Univ., Lafayette, Ind. School of Civil Engineering).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14–15, 1970.

Initial data on Strouhal frequency and lift for circular and triangular cylinders and for blockage between 7% and 44% are presented. It is found that, in that range, a simple continuity argument can account for blockage effects on the Strouhal number. The same argument is not satisfactory for correcting the oscillatory lift. For high blockages the oscillatory lift for steady cylinders decreases relative to the drag. The tendency towards self-excitation, however, may well increase when vortex-induced vibration gives way to a single-degree-of-freedom flutter. (11 references) (auth)

52877 (ANL-7685, pp 248-69) PROPOSED ANALYTICAL MODEL FOR THE CROSS-FLOW-INDUCED VIBRATIONS OF A CIRCULAR CYLINDER. Halle, H. (Argonne National Lab., Ill.).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14–15, 1970.

Flow-induced vibrations of an elastically supported circular cylinder with its axis oriented perpendicular to the flow direction are investigated. To mathematically represent the characteristic phenomena of the cylinder vibrations observed by previous experimenters, the semi-empirical analytical model developed considers the elastic interaction between the cylinder structure and the fluid flow to result in an oscillatory system. The model is very approximate, but does analytically generate most of the experimentally observed features. (9 references) (auth)

52878 (ANL-7685, pp 290-303) INVESTIGATION OF METHODS FOR COUPLED STRUCTURAL-HYDRODYNAMIC ANALYSIS OF REACTOR INTERNALS. Fabic, S. (Westinghouse Electric Corp., Pittsburgh, Pa. PWR Systems Div.).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14–15, 1970.

Calculation methods are investigated which could solve the coupled hydrodynamic and structural-dynamic equations for the downcomer region of a pressurized water reactor. The thermal shield and the core support barrel are considered to be the structural components which can interact with the pressure field in the liquid contained in the downcomer region. The local pressure or flow fluctuations caused by vortex shedding from trailing edges or from stall zones (jet switching) are to be modelled by the fictitious piston devices. (auth)

52879 (ANL-7685, pp 304-7) GENERATION OF POSITIVE AND NEGATIVE DAMPING WITH A FLOW RESTRICTOR IN AXIAL FLOW. Miller, D. R. (Knolls Atomic Power Lab., Schenectady, N. Y.).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14–15, 1970.

A fluid flowing past a vibrating body may absorb energy from the body, or it may supply energy to the body thereby generating positive or negative damping of the vibration of the body. A simple model is used to show how a fluid can generate either positive or negative damping. (auth)

52880 (ANL-7685, pp 308-11) EXCITATION OF A PURE TONE BY FLOW THROUGH AN ORIFICE. Miller, D. R. (Knolls Atomic Power Lab., Schenectady, N. Y.).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14–15, 1970.

Vortex rings may be shed periodically from the downstream side of an orifice. These vortices may excite acoustic resonances in a pipe. The characteristics of these jet tones and acoustic resonances are described. (auth)

52881 (ANL-7685, pp 312-20) FLOW-INDUCED INSTABILITY OF A THIN-WALLED CYLINDRICAL SHELL. Miller, D. R. (Knolls Atomic Power Lab., Schenectady, N. Y.).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14–15, 1970.

The author's previous theoretical analysis of the flow-induced collapse of flat plates is extended to the case where an incompressible fluid flows axially within a thin annulus bounded by one or two elastic thin-walled tubes. Expressions for the critical flow velocity for these two cases are derived. Some implications of flow velocities approaching the critical value are discussed. (24 references) (auth)

52882 (ANL-7685, pp 321-34) STABILITY ANALYSIS OF A RIGID BLADE IN PARALLEL FLUID FLOW. Zanoni, E. A.; Lowe, P. A. (Bettis Atomic Power Lab., West Mifflin, Pa.).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14–15, 1970.

A stability analysis for the prediction of flow-induced oscillations of a rigid flat blade in a rectangular duct is presented. The analysis permits two degrees of freedom as well as cross flow around the blade edges. The fluid conservation equations are linearized by assuming small perturbations about the steady-state-centered blade conditions. The linearized equations are introduced into the dynamic equations which describe the motion

of the blade. The stability of those equations subject to the constraint of the boundary condition is investigated by solving for the system's eigenvalues and eigenvectors. Thus, pure sinusoidal motion, damped sinusoidal motion and divergent motion are allowed. The model is compared with experimental data. (auth)

52883 (ANL-7685, pp 335-43) ANALYSIS OF THE FUNDAMENTAL VIBRATION FREQUENCY OF A RADIAL VANE INTERNAL STEAM SEPARATOR STRUCTURE. Kiss, E. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.).

From Proceedings of the conference on flow-induced vibrations in reactor system components, May 14-15, 1970.

The analysis of the fundamental vibration frequency of a radial vane internal steam separator has been performed considering the effect of the entrapped fluid between the idealized structure and pressure vessel wall. The hydrodynamic or "virtual" mass associated with a vibrating finite length cylinder is presented in terms of a correction factor to be used with the calculated two-dimensional "mass" effect. Finally, the lateral frequency of a radial vane separator assembly has been measured and compared with the predicted value. (auth)

52884 (DP-Report-217) DESIGN FEATURES AND TEST RESULTS OF THE MAIN CIRCULATORS FOR THE DRAGON REACTOR. Project DRAGON. (Brown, Boveri and Co., Ltd., Baden (Switzerland). Atomic Energy Establishment, Winfrith (England)). Oct 1963. 23p. (CONF-631012-3). Dep. NTIS.

From Dragon Project Engineering Symposium, Bournemouth, Eng.

The design and development of the main coolant circulators for the Dragon reactor are described. They are totally enclosed blowers with hydrodynamic gas lubricated bearings which utilize gas jacking for run-up and run-down. D. C. braking is also provided to minimize run-down time. (auth)

52885 (DP-Report-220) THE INSTALLED LEAK DETECTION SYSTEM OF THE DRAGON REACTOR EXPERIMENT. Project DRAGON. Enzmann, H. F. (Atomic Energy Establishment, Winfrith (England)). Oct 1963. 51p. (CONF-631012-4). Dep. NTIS.

From Dragon Project Engineering Symposium, Bournemouth, Eng.

A detailed description is given of the design and layout of the installed equipment to be used for detecting and measuring leakage of primary coolant in the Dragon reactor during operation. The main leak detection system will convey samples by carrier gas through small-bore pipes to a central detection unit sited within the reactor steel containment, the unit consisting of an activity monitor and a commercial helium leak detector. (auth)

52886 (DP-Report-223) SECONDARY CIRCUIT QUENCH TANKS FOR THE DRAGON REACTOR. Project DRAGON. Uschwa, H.; Krueger, M. (Borsig A. G., Berlin (West Germany). Atomic Energy Establishment, Winfrith (England)). Oct 1963. 45p. (CONF-631012-2). Dep. NTIS.

From Dragon Project Engineering Symposium, Bournemouth, Eng.

Failure of a primary heat exchanger tube in the Dragon reactor would allow ingress of active helium into a secondary circuit loop which would then cause the safety valves of this loop to open. Discharge of these valves must not be to atmosphere, and is into a closed vessel containing water—the quench tank. The design, development and testing of these quench tanks are described. (auth)

52887 (DP-Report-226) ERECTION OF REACTOR PRIMARY CIRCUIT. Project DRAGON. Pugh, J. (Atomic Energy Establishment, Winfrith (England)). Oct 1963. 24p. (CONF-631012-10). Dep. NTIS.

From Dragon Project Engineering Symposium, Bournemouth, Eng.

The design criteria, controls, erection, and testing procedures adopted for the Dragon reactor cooling system are summarized. (H.D.R.)

52888 (N-70-31885) POST-SHUTDOWN TEMPERATURE OF A BURIED REACTOR SYSTEM FOR A LUNAR BASED POWER PLANT. Wenzler, C. J.; Lustig, P. H. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). [1970]. 26p. (NASA-TM-X-52830). NTIS.

A study of the afterheat from delayed neutron fissions, fission product decay, and induced radioactivity was made on a Li cooled fast reactor system. The main sources of energy contributing to shutdown power are fission product decay and neutron induced activity of the Ta in the reactor core and pressure vessel. The delayed neutron contribution to shutdown power is negligible within 500 seconds after shutdown. The rate of temperature increase during the first several minutes after shutdown with no auxiliary cooling is low, making it unnecessary to establish the peak auxiliary cooling rate immediately after reactor shutdown. In all cases of reactor operating time, auxiliary cooling is required to prevent the system from overheating. Auxiliary cooling can be terminated when shutdown power has decayed enough so that passive cooling can reject heat at a high enough rate to prevent overheating. Auxiliary heating will probably be required to prevent the coolant from solidifying if the reactor has operated for only a short time (on the order of one day). (auth) (STAR)

52889 CALCULATION OF TIME-DEPENDENT PRESSURE INCREASE IN PRESSURE COMPARTMENTS OF PRESSURIZED-WATER REACTORS IN PRESENCE OF A LEAK IN THE PRIMARY CIRCUIT. Eichhorn, H.; Omieczynski, G. (VEB Kombinat Kraftwerksanlagebau, Berlin). Kernenergie; 13: 202-8(Jul 1970). (In German).

Prerequisites and derivations of systems of equations to calculate the time-dependent pressure increase in the pressure compartments designed as full-pressure, pressure-suppressing, or pressure-relief systems are presented. Calculations for the nuclear power stations Rheinsberg and Nord are given. The calculating programs for the two nuclear power plants differ from each other inasmuch as in the Rheinsberg nuclear power station the volume compensator has a nitrogen cushion and the primary circuit is arranged in some pressure compartments connected with each other by overpressure valves coming into action one after another when pressure increases in the compartments. In the Nord nuclear power station a vapor cushion is used for maintaining pressure, and the primary circuit is arranged in a big common pressure compartment. The results of calculating some versions are presented in diagrams. (auth)

52890 PRESSURE VESSELS AND PRIMARY COMPONENTS OF PRESSURIZED WATER REACTORS. Dorner, H. (Siemens AG, Erlangen, Ger.). Atomwirt., Atomtech.; 15: 463-8(Sep-Oct 1970). (In German).

With independent methods, it is shown that the danger of a containment vessel rupture during reactor operation can be excluded. Vessel defects, caused by human negligence during production, are likely to be detected during testing. Actual ruptures will most probably be preceded by leaks that are much smaller than those for which safety installations are designed. Since similar considerations are valid not only for the pressure vessel itself but also for all other components of the primary circuit that are pressurized, it is concluded that present-day engineering can achieve the high degree of safety required for reactors. (tr-auth)

52891 LIQUID METAL PUMPS. Rineiskii, A. A.; Aristarkhov, N. N.; Karpov, A. V.; Nikulin, M. P.; Tymosh, B. S.; Yarovitsyn, V. V. (Inst. of Physics and Power, Obninsk, USSR). pp 299-318 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970). (In Russian).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The development and practical application of pumps for the transfer of liquid metals began in the USSR at the time when liquid metals first started to be used as coolants. Interest in the subject became intensified after the introduction of Na-cooled fast reactors. Both mechanical and electromagnetic pumps have been developed. Types of mechanical and electromagnetic pumps and also a rational sphere of application for them are examined. Considerable space is devoted to mechanical pumps, particular attention being paid to the experience gained during ten years of operation of mechanical pumps in the BR-5 reactor. Results are given of experimental studies on hydrostatic bearings for operation in liquid Na and some data are quoted on pumps used in the BN-350 reactor. 6 references. (auth)

52892 DEVELOPMENT OF SODIUM PUMPS FOR RAPSODIE, PHENIX, AND SUBSEQUENT FAST BREEDER REACTORS. Raczynski, W. (Hispano-Suiza, Bois-Colombes, France); Delisle, J. P.; Befre, J. L. pp 331-42 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970). (In French).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The extremely satisfactory performance of the RAPSODIE pumps is the culmination of six years of research and trials carried out on different Na pumps at temperatures up to 600°C and over. The PHENIX pumps stem directly from those of RAPSODIE in general principle and design but their capacity is very much greater. However, a certain number of new problems have arisen, such as that of the flexible connection with the return piping.

Trials are already proceeding on certain pump sub-assemblies and water tests on complete pumps are to follow. 3 references. (auth)

52893 SODIUM PUMP DEVELOPMENT. Fakkel, R. H. (N. V. Neratoom, The Hague). pp 343-74 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

Research and development work on liquid pumps in the Netherlands is described. Due to the high operating temperature, emphasis is laid upon the right choice of constructional material; this is a special cast of AISI 304-type stainless steel, with narrowed limits for Ni (for good weldability) and Cr (to prevent sigma-phase formation). Other typical problem areas are: shaft-seal development, hydrostatic Na-lubricated bearings, choice of a single suction impeller, fit for cavitation-free operations under conditions of a low available NPSH. Two pumps have been built, both of the free-surface, vertical, one-stage type. The first is an experimental pump of small capacity (280 m^3/h) and high speed. Valuable experience has been gathered relating to the construction material, the material used for hardfacing the grooved hydrostatic bearings, and the shaft seals, for which a visco-type was developed. A larger pump, with a capacity of 5000 m^3/h has been designed and built according to SNR-specification. This is a full-scale prototype pump for the SNR. Commissioning is due in October 1970 in the Interatom pump test facility in Germany. By careful designing, sustained by hydraulical experiments, the impeller wheels operate extremely well, i.e., without causing cavitation, under conditions of a low system NPSH. Measuring techniques were developed to determine the occurrence of cavitation (by means of adding acrylic resin to the impeller wheel). Test rigs for determining the optimum design for the grooved hydrostatic bearing, for the right choice of hard-facing materials (stellites and cermets) and for visco-seals have been erected and are in operation. 12 references. (auth)

52894 DEVELOPMENT OF MECHANICAL SODIUM PUMP. Oda, Y.; Suzuki, A.; Kawahara, S.; Sagawa, N.; Komatsu, T.; Ito, Y. (Hitachi Ltd., Tokyo). pp 375-95 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

Mechanical vertical-type centrifugal Na pumps have been made and tested on high-temperature sodium. The small test Na pump having a capacity of 60 m^3/h and a total head of 40 mNa is connected to the 4B-discharge piping, which is provided with a pressure gauge filled with NaK, an electromagnetic flow meter, an orifice flow meter, and a throttle valve sealed with a bellows. Test results were very satisfactory and engineering data useful for developing large mechanical pumps were obtained. Experiences gained from the small test pump, such as the axial temperature distribution in the pump, characteristics in high-temperature Na at 300 to 450°C, vibration tests and results of a continuous running test, and the outline of the program for large Na pumps in Japan are described. 6 references. (auth)

52895 NITRIDING OF FERRITIC AND AUSTENITIC STEELS IN A NITROGEN COVER-GAS CONTAINMENT FOR A SODIUM-HEATED STEAM GENERATOR. Grosser, D. (INTERATOM, Bensberg, Ger.). pp 417-30 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

Nitrogen is normally used for cover-gas duties in Na piping systems to avoid the risk of burning after a leak has developed. During operation of the 5-MW test facility, a leak outwards in the ferritic pipe of a meander-shaped tube-in-tube Na-heated steam generator occurred. The steam generator was housed in a N_2 cover-gas containment, and because of the small size of the leak, as indicated by instrumentation, operation was nevertheless continued. During dismantling of the steam generator for post-operational metallurgical examinations, an elbow-shaped tube broke indicating that there must have been grave damage to the tube material. Careful inspections of two Na pipes revealed strong nitriding of the ferritic and austenitic steel components. The extent of nitriding increased with ascending pipe wall temperatures (temperature up to 510°C) during plant operation and reached maximum N_2 contents of up to 0.3 wt % compared with 0.02 wt % in the as-received condition. The nitrided case thickness of the ferritic material was up to 0.4 mm. The results of the short-time tensile tests and flattening investigations performed with material taken from defined locations in the steam generator tubes are presented. The tests show an increasing deterioration of tube material with rising N_2 contents. An investigation program was started to reproduce the unexpectedly high nitriding of steel. As part of a complete study tests were conducted to evaluate the effect of certain parameters on the nitriding behavior of steels. Long-time annealing was carried out on steel specimens at 560°C in pure N_2, and in N_2 with small O_2 and H_2 contents, respectively. These additives were used to simulate the impurities present in the cover gas. The tests did not reveal any nitriding of material as proved by metallographical and analytical techniques. Only when N_2 and Na vapor were used simultaneously was a nitrided case formed on the materials to the same extent as observed on the surface of the steam-generator material. Data are presented from these preliminary investigations, in which the effect of temperature on the nitriding behavior of materials under a given Na vapor partial-pressure was examined. 12 references. (auth)

52896 STEAM-GENERATOR AND INTERMEDIATE HEAT-EXCHANGER DEVELOPMENT. de Clercq, W. J. C.; van Waveren, N. J. (N. V. Neratoom, The Hague). pp 433-53 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The steam-generator and intermediate heat-exchanger development carried out by Neratoom for Na-cooled fast reactors is reviewed. The reference designs of these components for the SNR-prototype are discussed and the development of an alternative steam-generator design is also indicated. Designs are presented of models of the steam generator and heat exchanger, which are now under construction and which will be tested in the 50-MW Na loop at Hengelo. Problem areas are given in more detail in the theoretical and experimental work carried out to solve these problems. Concerning stress calculations, a method has been developed to calculate the stresses in steam-generator tube-sheets resulting from mechanical and thermal load. The calculated stresses are compared with the results of photo-elastic and strain-gauge measurements. Special design features are developed to minimize thermal loads on the tube-sheets. Calculation methods are given to predict the thermal performance of the steam generator. Attention is given to two-phase flow stability in the evaporator and to the influence of an unbalanced flow of feed-water and Na on the temperature distribution in the evaporator. Hydraulic models using water as the working fluid have been utilized. These experiments were meant to study the pressure loss, flow distribution and vibrations in Na inlet and outlet boxes, cross flow at the inlet and outlet of the bundle, the support grids and parallel flow in the tube bundle. The behavior of the protecting shields at the tube-plates has been verified also. Experimental work in Na loops has been concentrated on the thermal shock resistance of the tube-sheets and the tube to tube-sheet connections. A special design feature in the steam generator is the bellows in the shell. Experimental work on this component is discussed. For the SNR heat-exchanger design, a method is described for locating leaking tubes and plugging individual tubes; experimental work on this method is mentioned. 10 references. (auth)

52897 DESIGN OF THE SODIUM-HEATED STEAM GENERATOR FOR THE FBR NUCLEAR POWER STATION. Kawahara, S. (Hitachi Ltd., Omika, Japan); Ogasawara, H.; Yamanouchi, A.; Tachi, Y. pp 489-504 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

Several design points for the steam generator were studied, and the constructional and systematic design concepts of the steam-generator system selected. Selections between several flow sequences are discussed in relation to the tube arrangements, where the required heat-transfer areas are compared in the cases of systems with a reheater and without a reheater, in the cases of systems with once-through evaporator and superheater zones and with separate superheater tubes, and in the cases of the positions of the reheater either installed in parallel or in series with the evaporator zones. To establish tangible relations between thermal conditions and hardwares, sensitivity analyses were performed to give useful information for plant optimization. So far, optimizing the design of steam-generator systems has been accomplished by taking the initial investment costs of main system components as the target function, where the arbitrary variables are overall temperature conditions, tube diameters, tube gradients in helically coiled parts, allowable steam velocities, and steam conditions. From these procedures an optimum group of these variables has been calculated, which are referred to in sizing the design parameters of the prototype steam-generating system for PNC's 300-MW(e) plant. Several operational performances are discussed in reference to the above sample design, especially in the field of partial load operation and hydraulic stabilities, and permissible operatabilities are concluded. The features of the design are as follows: U-type helical coil tube with thermally shielded downcomer region in the evaporator; unit type separated into super-

heater-evaporator and reheater; operational stability from the dynamic and static point of view, even at 30% partial load operation; partial load operation with the same steam temperature as the rated condition; the tube sheet is kept above the sodium level; inspectable tubes and shell arrangements. 4 references. (auth)

52898 DEVELOPMENT IN FRANCE OF STEAM GENERATORS HEATED BY LIQUID SODIUM. Robin, M. G. (CEN, Saclay, France); Befre, J.; Cachera, P.; Fouche, L.; Lions, N.; Pouderoux, P. pp 505-25 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970). (In French).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The PHENIX steam generators represent the first industrial production of equipment of this type in France. Manufacture of the full-scale generators was preceded by various experiments, the first dating from 1957. The theoretical and experimental studies carried out within the framework of the PHENIX project, for the benefit of the Na cooled fast reactor program as a whole, have provided valuable information relating to the design, selection of materials for and testing of large steam generators such as are likely to be built during the next decade. The properties sought for these units are (in order of importance): a high measure of safety; the greatest reliability; and minimum cost. Various designs are studied, their common features being a modular construction (the unit power of a module may be several hundred MW(t)) and utilization of tube bundles with tube diameters of at least 20-mm spacing and wall thickness being selected in such a way as to allow adequate time for detection of leaks and isolation of the module. A limitation of the steam temperature to 510°C is now seen to have advantages. With a view to avoiding stress corrosion by chlorides, manufacturers are planning to use ferritic steels for the entire unit, and this will also contribute to a reduction of costs. 12 references. (auth)

52899 DESIGN AND DEVELOPMENT OF BOILERS FOR THE SODIUM-COOLED FAST REACTOR. Bauly, J. A. (Clarke Chapman and Co., Gateshead, Eng.); Breen, B. V. pp 527-48 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The experience of boiler making for gas-cooled reactors is relevant to sodium-cooled reactors. The design of boilers for sodium-cooled reactors is discussed and it is shown how certain features are common to gas-cooled reactor boilers, for example, problems of dry-out, tube vibration, fretting, and thermal stressing. Additional features specific to Na cooling arise from its heat-transfer properties, its chemical properties, and the special need to guard against the consequences of the Na steam reactions. These features are also discussed. Factors affecting the choice between steam-generator schemes are outlined. The relative capital cost of three power-station steam-generator schemes which are of interest in the present state of development of Na-cooled fast reactors is examined. These are a once-through and a recirculating design operating at 2300 lb/in^2, and a supercritical design operating at 3500 lb/in^2 at the turbine stopvalve. Evaporators, superheaters and reheaters are considered and the design and construction of the units are described. A table of chosen parameters is given, together with a detailed description of the heat-transfer correlations used in sizing the heaters. The extent of supply taken into account in the study is given as well as the exclusions, and the results are presented as relative price levels for the three plants, broken down into their component parts. 17 references. (auth)

52900 SOME COMMENTS ON SODIUM/WATER REACTION PROBLEMS FROM THE VIEWPOINT OF A POWER STATION PURCHASER AND OPERATOR. Bolt, P. R.; Carruthers, H. M. (Central Electricity Generating Board, London). pp 549-66 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The possible damaging effects of a sodium/water reaction are considered in relation to practical steam-generator designs. Failure statistics for CEGB heat-exchange plant are presented together with a discussion of the applicability of these data to fast reactor boiler plant. The assessment of the steam-generator sodium-side design pressure and the required capability of the pressure-relief and boiler shut-down systems are considered. The need for operationally reliable and sensitive methods of detecting water/steam leakage is stressed. Experimental data on the times during which small water leaks within specific size ranges can be tolerated are currently insufficient; the operational implications of this aspect of the boiler-leakage problem are considered. Possible methods of leakage location are mentioned together with experience of these methods on CEGB plant. The considerable problems that can be associated with the inspection and repair of large, closely pitched tube bundles are discussed. Approximate estimates of steam-generator outage times for straightforward single tube plugging are given. Estimates are presented of the order of outage costs that may be associated with repairs following a sodium/water reaction. Indicative outage costs for the repair of boiler leaks on other types of nuclear and conventional generating units are provided to give perspective to the assessment. 8 references. (auth)

52901 LMFBR STEAM-GENERATOR DEVELOPMENT AND TESTING. Hobson, R. G. (Westinghouse Advanced Reactors Division, Madison, Pa.); Eilbeck, E. pp 567-93 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The results of the first two phases of a comprehensive development program for a LMFBR boiler are presented. A once-through steam generator which utilizes Incoloy 800 tubes within a stainless-steel shell is the reference design. The optimization studies indicate that a tube length of about 100 ft is required. A tube length of 100 ft requires some form of bending or coiling and candidate designs employ either helical coils or serpentine bends. At this time, a serpentine design has been chosen since this results in comparatively simple repeatable bends in only one plane and the tubes are more easily assembled into a bundle. Incoloy 800 has been chosen as the tubing material because it permits utilization of one material in both the boiling and superheat regions of the unit, its material characteristics are compatible with both Na and water. 6 references. (D.D.C.)

52902 Alco/BLH STEAM GENERATOR OPERATING EXPERIENCE IN THE SCTI. Gimera, R. J. (Liquid Metal Engineering Center, Canoga Park, Calif.). Contract AT(04-3)-700. pp 595-627 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The Sodium Components Test Installation is operated at temperatures to 1200°F and energy input level of 35 MW(t). The components currently under test in the SCTI are an intermediate heat exchanger designed and fabricated by Alco and steam generator designed by Alco and fabricated by BLH. The steam generator was designed to operate at a steam temperature of 1050°F, steam pressure of 2200 lb/in^2(gauge), feedwater inlet temperature of 600°F, and steam flow-rate of 116,000 lb/h when heated by Na flowing at 855,000 lb/h and inlet temperature of 1175°F. The test program for the IHX and steam generator consisted of facility performance tests, steady-state component tests, and transient and dynamic component tests. Component instrumentation consists of thermocouples, strain gauges, vibration accelerometer, hydrogen detectors, and Na-level gauges. During the facility performance tests, anomalous performance of the steam generator resulted in plant shutdown. First symptoms were exit steam temperature greater than inlet sodium temperature. This, and other supporting data, established that a Na-water reaction had occurred. Post-shutdown diagnostic tests isolated the leak to a defect in a single steam tube within the region of the upper tube sheet. Two tubes were subsequently plugged. During this investigation, cracks in the manway opening O-ring groove were discovered. The O-ring seal joint was replaced with a welded diaphragm seal. Analysis of data from the 20% and 40% power level tests, prior to the tube leak, revealed anomalous heat transfer behavior of the steam generator. At the 20% power level, the unit performed as predicted; at the 40% power level, performance was much poorer than predicted. It appeared that the onset of film boiling was occurring in the unit at a heat flux of 50,000 Btu/h ft^2 and temperature differences of 100 to 300°F and that extrapolation of these data would limit the capability of this unit to approximately 50% of its design value. A test series was devised to further explore this problem. (auth)

52903 EXPERIMENTAL RESULTS OF A SMALL-SCALE SODIUM-TO-SODIUM HEAT EXCHANGER AND SODIUM-HEATED STEAM GENERATOR. Naganuma, T. (Mitsubishi Atomic Power Industries, Inc., Omiya City, Japan); Nakai, Y.; Watanabe, T.; Kiyokawa, T. pp 629-55 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

A small-scale Na-to-Na heat exchanger (IHX) and a Na-heated steam generator (SG) were manufactured and tested by MAPI and MHI as part of the research support for the development of the

large-scale unit of improved design. The IHX has a U-shape, shell- and -tube structure with a capacity of about 1 MW and the SG has a single helical coil tube and is of the uniflow type with a capacity about 140 kW. The Na inlet and outlet temperatures are about 550, 400°C and 370, 520°C respectively and the Na flow-rate is 11,500 kg/h for the IHX. The Na inlet temperature, Na flow-rate, steam outlet temperature, steam pressure of the SG are about 500°C, 60 l/min, 343°C, 155 kg/cm² (gauge) respectively. The IHX and SG were installed between the 2B primary Na loop, the 1B secondary Na loop and water loop and tested for about 2400 and 1400 hours respectively. Experiments were carried out on the following items and effective results were obtained: Pe number versus Nu number of the shell side and overall heat-transfer coefficient of the IHX; temperature rise of sodium in the shell along the centerline of the IHX; pressure drop of flow both inside the tube and shell of the IHX; Nu number versus Pe number and Re number of Na versus overall heat-transfer coefficient and Bi number of Na for the SG; the characteristics of the emergency drain system of Na and water of the SG; the functions of the H_2 meter of the SG; and a metallurgical check of the 2¼ Cr-1Mo water tube of the SG on samples cut after operation. (auth)

52904 LEAK DETECTION IN SODIUM-HEATED STEAM GENERATORS. Ford, J. A.; Chamberlain, H. V.; Coleman, J. H.; Lindsey, P. S. (Atomic Power Development Associates, Inc., Detroit). pp 657-79 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The development of leak-detection systems for Na-heated steam generators is required to minimize the damage and consequent large costs which can result from a Na/water reaction. An evaluation of detection instruments for small leaks was conducted since adequate detection systems for large leaks are currently in use. Typical large steam generators and reheaters constructed of 2¼ Cr−1 Mo steel and stainless steel were evaluated. The criteria developed for evaluating candidate leak detectors requires the detection of a leak in time to allow shut-down before significant repairs (beyond plugging the leaking tube) are necessary; or as an alternate criteria, to require shut-down before secondary tube failures have occurred. The candidate leak detectors evaluated were: the cover gas chromatograph; thermal conductivity cell, and pressure detector; the in-Na rhometer, plugging meter, electrochemical O_2 meter and H_2 detector; and the acoustic detector. The evaluation included the system-transport times, detector sensitivity, response time, operator-interpretation time and steam-generator isolation and dump time. The damage rates were obtained from wastage data for jet-type leaks which are believed to be the most damaging; and a model was developed for representing the reaction-product distribution in the system with time. The leak-rate, plant load, location of the leak, and base level of Na impurities were variables in the evaluation. The evaluation showed that less than a minute was available for detecting leaks of 10^{-1} to 10^{-3} lb/s in some locations. Instruments currently used to detect small leaks (cover-gas detectors) are inadequate to meet the criteria. The most promising detectors are the electrochemical O_2 and H_2 meters; however, these cannot prevent damage under all circumstances. The acoustic detector has undergone a minimum of development, however, limited experimental data indicate it has the greatest potential for fulfilling the criteria. The detector requirements are considerably reduced if jet-type leaks are not credible or if materials more resistant to wastage such as Incoloy 800 are used. This evaluation demonstrates the need for determining the types of leaks which can occur; accelerating the development of the acoustic, H_2, and electrochemical O_2 meters; and qualifying materials more resistant to wastage for use in steam generators. 17 references. (auth)

52905 STUDIES OF HEAT TRANSFER AND PRESSURE DROP RELEVANT TO SUB-CRITICAL ONCE-THROUGH EVAPORATORS. Lee, D. H. (Atomic Energy Establishment, Winfrith, Eng.). pp 681-701 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The experimental data published on high-pressure water heat transfer are reviewed. New experiments are described which study the thermal performance of once-through evaporators. Tests have been carried out with 9- and 13-mm bore tube at pressures between 14 and 18 MN/m² with sufficiently low heat flux/mass velocity ratios to be representative of current steam-generator design. Over a range of flux and velocity, dry-out steam quality, dry-out temperature rise, and post-dry-out heat-transfer coefficients are compared with predicted values using existing correlations; improved correlations are presented. The significance of pressure on dry-out temperature rise is discussed. Measurements of boiling pressure drop have been carried out and these are compared with predictions made using the "homogeneous" and "slip flow" models. A change of pressure gradient is observed in a region just downstream of dry-out and new equations for predicting pressure gradient in this region are developed. 31 references. (auth)

52906 INTERMEDIATE COOLANT ALTERNATIVES FOR THE LMFBR. Latzko, D. G. H. (Delft Univ. of Tech., Netherlands). pp 715-35 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

Present-day safety philosophy for LMFBRs implies the use of an intermediate cooling circuit between the reactor coolant and steam systems to protect the reactor core against the consequences of a Na-water reaction. So far Na has been the favored choice for intermediate coolant with NaK as the only serious alternative. The viability of using molten salts for this purpose is analyzed. After first discussing the general requirements for LMFBR intermediate coolants it is pointed out that some of the most important ones, such as chemical stability and low vapor pressure at high temperatures as well as low chemical reactivity with Na and steam, are met by some molten salt mixtures. The effects of such a substitution on the equipment will be twofold: heat-transfer surfaces will increase both in size due to the lower heat-transfer coefficients attainable and in specific cost due to the limited choice of construction materials compatible with the most attractive salt mixtures, while on the other hand the size of pumps and piping decreases markedly due to the much higher heat-absorbing capacity (specific heat × density) of the salts. A corollary of this latter effect is the lower specific pumping power required. The consequences of these changes for plant layout, capital costs and running costs are examined for a large-scale LMFBR generating unit. Furthermore, some attention is paid to the compatibility aspects of various salt mixtures with Na and steam, as well as to the special design features of salt-heated as compared to Na-heated steam generators. Finally some conclusions are given concerning the desirability for further investigations on this line of intermediate coolants. 9 references. (auth)

52907 VALVES FOR LIQUID-METAL SERVICE. Milleville, B. J. (Rockwell Mfg. Co., Pittsburgh). Contract AT(30-1)-4025. pp 839-51 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

Severe operating conditions combined with the need for dependable total containment of high-temperature radioactive liquid Na create serious practical problems relative to the configuration and performance of most conventional types of valves. Requirements that designs satisfy applicable criteria for thermal stress fatigue life can be met only by analysis of the results of substantially complete stress analyses. In the usual non-geometric, asymmetrical shapes or parts of shapes of most valves, analysis is inherently difficult and the accuracy thereof highly suspect. Heavy sections and abrupt, massive discontinuities suggest that even if determination of stresses by calculation or experiment were no problem, the value of the stresses, however determined, would prove unacceptable as related to the long-life reliability requirements. To maximize the likelihood that designs selected will prove capable of remaining safe and functional throughout specified service life, and lend themselves reasonably to the analyses necessary to justify such expectation, basic concept guidelines have been established. These provide that valves will be weld-fabricated, will be basically symmetrical about the flow-way centerline, will be designed to assure generally uniform heating and cooling rates in all sections, and will be operable with a minimum of mechanical energy delivered through the pressure vessel wall. For operating shaft or stem seals the approach meriting the highest confidence in assuring long-life reliability is considered to be an inert gas blanket-protected freeze seal applied to a rotating, non-translating shaft. Provisions are made for prevention of transport of oxides to the cool Na zone of the seal. By use of heavy Cu heat conductors, a passive high-flux heat sink is concentrated in a relatively short seal zone. This avoids excessive operating torque and provides a compact and reliable assembly. Review of gate, butterfly, and ball-valve structural characteristics indicates that for most applications they cannot reasonably satisfy these guideline requirements. Most valves having line-of-sight continuity of the flow stream in the open position require movement, under heavy fluid-pressure load, of the closure element. The serious attendant problems of high bearing loads and excessive operating energy appear to be beyond the capabilities of available engineering materials. New axisymmetric sleeve-type valve concepts provide substantial balancing of the fluid pressure load. It is believed these concepts will have extensive general application in Na-cooled fast reactors of the future. (auth)

52908 ENVIRONMENTAL DESIGN FACTORS FOR SODIUM-COOLED FAST REACTORS COMPONENTS. Goldmann, K. (United Nuclear Corp., Elmsford, N. Y.). pp 905-21 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

In establishing wall-thickness criteria and allowable stress limits for the design of Na components, such as heat exchangers, pumps, valves and piping, one must consider the effects of the Na and other environments. Corrosion rates and adjustment factors for strength properties which are proposed for modifying wall-thickness criteria and allowable stress limits are analyzed. The selected materials of construction are those which are being considered in the Liquid Metal Fast Breeder Reactor (LMFBR) Program. They are types 304 and 316 stainless steel, including both H and L grades, and 2¼ Cr-1 Mo alloy steel. Wall thinning is covered by a corrosion allowance. Equations and a graph are presented for calculating corrosion allowance on the Na side as a function of operating temperature, time and O_2 concentration in the Na. Corrosion allowance for external environments such as air or O_2-depleted gases is also covered. Strength properties of the materials are affected by exposure to Na. The principal effects are due to carburization or decarburization of the materials. Methods and graphs are presented to permit an estimation of carbon transfer and resultant changes in strength properties as a function of operating variables for different combinations of materials in the hot and cold legs of Na systems. Other possible effects due to N_2 transfer are mentioned. 15 references. (auth)

52909 DEVELOPMENT IN FRANCE OF LIQUID SODIUM STEAM GENERATORS. Robin, G. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France); Beffre, J.; Pouderous, P.; Fouche, L.; Cachera, P.; Lions, N. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 83, 5-22(May-Jun 1970). (In French).

Theoretical and experimental studies carried out in the framework of the Phenix project, in conjunction with the development of sodium cooled fast neutron reactors, led to important developments in the materials and tests on high power steam generators. The following criteria were sought: maximum safety, maximum reliability and minimum costs. The various configurations studied were constructed from modules (the power per module could reach several hundred thermal MW). The array of tubes with diameters of less than 20 millimeters was designed so that a small leak could be detected and the module isolated. Advantages in limiting the vapor temperature to 510°C were seen. Ferrite steels were recommended as being of low cost and resistant towards chloride corrosion. (auth) (France)

52910 DEVELOPMENT IN FRANCE OF THE TECHNOLOGY OF FAST REACTORS WITH SODIUM COOLED CORES. Leduc, J. (Centre d'Etudes Nucleaires de Cadarache, Saint-Paul-les-Durance, France); Ginier, R.; Jallade, M.; (and others). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 83, 32-45 (May-Jun 1970). (In French).

The control of the sodium flow through the fuel assemblies is studied in relation to fly off from the assemblies and the principles of the assembly positioning. Tests carried out to avoid sodium cavitation and vibrations are described. The expansion of the steel structure of the core poses new and difficult problems. (auth) (France)

52911 NUCLEAR REACTOR WITH INTEGRATED HEAT EXCHANGER. (to Commissariat a l'Energie Atomique). British Patent 1,208,616. 14 Oct 1970. Priority date 24 Feb 1967, France.

HEAT EXCHANGERS—design parameters of removable integrated, for gas cooled or boiling reactor
REACTORS, BOILING—heat exchangers for, description of removable integrated
REACTORS, GAS-COOLED—heat exchangers for, description of removable integrated (D.C.C.)

52912 IMPROVEMENTS IN AND RELATING TO THE HEAT-INSULATING SCREENING OF REACTOR PRESSURE VESSEL WALLS. Junkerman, Wolfgang (to Babcock and Wilcox Ltd.). British Patent 1,207,036. 30 Sep 1970. Filed 4 Dec 1968.

Reference is made to cellular screen constructions for water-cooled reactors. A screen is described for impeding heat flow from the coolant to the concrete pressure vessel comprising enclosed inclined cells of which the ends further from the pressure vessel wall are higher than the ends nearer the wall and are filled with water in communication with reactor coolant and with pervious masses of piled non-water absorbent draining bodies of low thermal conductivity. These draining bodies may take the form of piled U-shaped glazed porcelain strips. Various alternative constructional arrangements are described. The cells may be provided with siphon tubes for emptying purposes. (UK)

52913 STUDIES ON THE KINETICS OF THE WATER-STEAM SECONDARY SYSTEM OF A NUCLEAR POWER PLANT. Rousseau, J. C.; Dobremelle, M. (CENS, Gif-sur-Yvette, France). Atompraxis; 16: 269-73(Jul-Aug 1970). (In French).

A method of numerical resolution is given for fluid mechanics equations applied to the dynamic operation of a two phase flow system. An application is made on large and rapid changes of the input parameters of a steam generator of the once-through type, with a gas as primary fluid and water as secondary fluid. Calculation data are compared to experimental values. A computation code based on this method describes the whole of steam-water secondary system of a gas-cooled nuclear power plant. In particular, general regulation and incidents problems can be treated with the code. (3 references) (auth)

Fuels

Refer also to abstracts 50494, 51192, and 52958.

52914 (DP-Report-291) THE DEVELOPMENT OF FUEL AND CORE MATERIALS FOR HIGH-TEMPERATURE POWER REACTORS. Project DRAGON. Graham, L. W.; Saunders, R. A. (Atomic Energy Establishment, Winfrith (England)). Aug 1964. 29p. (CONF-640421-1). Dep. NTIS.

From Symposium on the Assessment Studies for a H.T.G.R., Bournemouth, Eng.

The fuel development work is described, particular emphasis being placed upon features having an application to a power reactor. A survey of experience available on irradiation damage of graphite and recommendations concerning its application as a core material are included. The use of DRAGON as an irradiation facility and the supporting work envisaged in connection with power reactor fuel element development are surveyed. (auth)

52915 (IN-1389) BRITTLE BEHAVIOR OF ZIRCALOY IN AN EMERGENCY CORE COOLING ENVIRONMENT. Meservey, R. H.; Herzel, R. (Idaho Nuclear Corp., Idaho Falls). Sep 1970. Contract AT(10-1)-1230. 30p. Dep. CFSTI.

Scoping tests were conducted to determine the extent and nature of embrittlement of Zircaloy under high temperature conditions. The purpose of these tests was to provide information on Zircaloy embrittlement that could be used in the planning of other experimental programs, particularly those programs in which heat transfer processes under loss-of-coolant accident conditions are being studied through use of Zircaloy-clad electrical heaters as fuel pin simulators. The information acquired was to be used to predict the capability of Zircaloy-clad electrical heaters to withstand loss-of-coolant tests and to assess the effect of the environment during a loss-of-coolant accident (LOCA) on the brittle nature of the Zircaloy fuel cladding. Samples cut from Zircaloy tubing were exposed in a steam environment at temperatures typical of those predicted for an LOCA. Physical and metallurgical properties of the tubing were determined before and after the exposures. In addition to the degree of embrittlement, changes in tubing dimensions, weight, and electrical resistivity were determined for a wide range of temperature histories. The degree of protection against embrittlement afforded by a corrosion film previously deposited on the tubing was also investigated. (13 references) (auth)

52916 (WCAP-3385-24) SAXTON PLUTONIUM PROJECT QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING JUNE 30, 1970. Smalley, W. R. (Westinghouse Electric Corp., Pittsburgh, Pa. Nuclear Energy Systems Div.). Jul 1970. Contract AT(30-1)-3385. 12p. Dep. NTIS.

NEUTRONS—effects on mechanical properties of Zircaloy clad plutonium oxide (PuO_2)-uranium oxide (UO_2) fuel elements, (E)
PLUTONIUM—use in pressurized water reactor fuels, (E/T)
PLUTONIUM OXIDES PuO_2—PuO_2-UO_2, radiation effects on burnup, microstructure, and mechanical properties of pressurized water reactor fuel elements of Zircaloy clad, in-pile, (E)
REACTORS, PRESSURIZED-WATER—fuels for, use of plutonium in, (E/T)
REACTOR FUEL ELEMENTS—performance of Zircaloy clad plutonium oxide (PuO_2)-uranium oxide (UO_2), in pressurized water reactors, (E/T)
SAXTON POWER REACTOR—fuel elements for, in-pile performance of Zircaloy clad plutonium oxide (PuO_2)-uranium oxide (UO_2), (E/T)
—operations during March to May 1970, summary of Core 3

ZIRCALOY — radiation effects on mechanical properties of fuel element cladding of, (E)
URANIUM OXIDES UO_2 — PuO_2 — UO_2, radiation effects on burnup, microstructure, and mechanical properties of pressurized water reactor fuel elements of Zircaloy clad, in-pile, (E) (D.C.C.)

52917 HYDRAULIC PERFORMANCE IN ROD BUNDLES OF FAST REACTOR FUELS: PRESSURE DROP, VIBRATION, AND MIXING COEFFICIENT. Okamoto, Y. (Power Reactor and Nuclear Fuel Development Corp., Tokyo); Hishida, M.; Akino, N. pp 175-86 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

Fast reactor fuel-rod clusters consist of a parallel hexagonal matrix forming narrow interconnected channels. Sodium coolant flows through the inter-channel and removes the heat at a high flux-rate from the reactor core to the heat sink. The liquid metal coolant in removing heat from fast reactor fuel elements has introduced many hydraulic problems. The hydraulic performance of a rod bundle is composed of three components, namely: pressure drop, vibration, and mixing coefficient. Hydraulic tests on full-scale mock-up fuel assemblies of the Japan Experimental Fast Reactor (JEFR) are described with the results from several flow experiments with sodium, water and air. In general, sodium is to be used as coolant in the JEFR. However, fuel flow tests in sodium can become quite time-consuming and expensive. Water and air are often used as substitute test fluids. However, the accuracy of the dynamic similarity obtained from tests with water, air and sodium has not been analyzed. Hydraulic flow tests on fuel assemblies show that the value of the friction factor in a sodium flow are fairly coincident with the values in water and air. A turbulent and swirling flow in the cluster induces a lateral vibration of fuel rod assemblies. The dynamic behavior of the fuel pins has been measured by the use of strain-gauge foils and piezometric elements. The result of the tests was that the measured values of frequency and amplitude of a fuel sheath were found to be sufficiently lower than the critical stress limit of the structural materials. Mixing in the inter-channels of fuel assemblies minimizes the variation with the outlet temperature of their channels, and thereby improves heat transfer characteristics. Mass-transfer analysis tests using a diffused concentration method with potassium iodide give the result that the lateral diffusion behavior is similar to the distribution calculated by a homogeneous diffusion theory. The planning of a thermal mock-up diffusion test using a Na-fuel flow test loop is described in detail. 8 references. (auth)

52918 FUEL ROD BUNDLES WITH VARIOUS SPACER DESIGNS FOR SODIUM-COOLED FAST REACTORS. Baumann, W.; Hoffmann, H.; Moeller, R. (Kernforschungszentrum, Karlsruhe, Ger.). pp 187-201 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The pressure drop in a Na-cooled multirod fuel element and the temperature profile across its outlet section are calculated as a function of different rod arrays for grid- and helical-type spacers. These considerations are based on experimental pressure drop and coolant cross-mixing investigations. Grid-type designs and helical designs are compared. 12 references. (auth)

52919 DETERMINATION OF VIBRATIONS AND PRESSURE DROPS IN A FAST REACTOR FUEL ASSEMBLY. Wuidar, R.; Plumier, M.; Gilly, L. (Ateliers de Constructions Electriques, Charleroi, Belg.). pp 217-31 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970). (In French).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The modes, frequencies and vibration amplitudes of the pins of a fuel assembly on multiple elastic supports are calculated. The pressure drop across this multiple-grid assembly is calculated as a function of the type of grids and manufacturing tolerances. Calculations are made as realistic as possible with a minimum of hypotheses. 9 references. (auth)

52920 DEVELOPMENT IN FRANCE OF THE CORE TECHNOLOGY OF SODIUM-COOLED FAST REACTORS, AND FUTURE PROSPECTS. Leduc, J. (CEN, Cadarache, France); Ginier, R.; Jallade, M.; Marmonier, P.; Ratier, J. L.; Skok, J.; Barrau, P.; Demargne, F. pp 249-72 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970). (In French).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

Hydraulic and structural problems of core technology have in many cases been solved differently in PHENIX and RAPSODIE since these two reactors do not have the same size and characteristics. However, most of the solution adopted for PHENIX can be utilized for a large reactor through the improvements presented which deal with control of flow-rates, systems to prevent subassembly lifting, Na mixing in fuel-pin bundles, vibration measurements and principles of assembly positioning. Swelling of the steel of core structures raises new and difficult problems. (auth)

52921 FUEL ROD PROBLEMS IN THERMAL AND FAST REACTORS. Hoechel, J. (AEG-Telefunken, Grosswelzheim, Ger.); Stehle, H. Atomwirt., Atomtech.; 15: 449-58(Sep-Oct 1970). (In German).

Fuel rods for water reactors presently can be considered as well-established and proven. Defects, if occurring, reside in deficiencies during manufacturing that can be avoided. For boiling water reactors, purity of the cooling system can be sufficiently controlled to avoid deposition of boiler scale. Development of fuel elements for fast reactors requires establishment of a systematic study program. Oxide rods for sodium-cooled reactors were developed in principal but were not tested, as yet, for long-term operation, for high cladding temperature, and for high power. Moreover, interaction of fission products requires further study. Carbide, nitride, or mixtures represent promising possibilities for advanced fuel elements. Many problems remain to be solved as to optimal fuel elements and their arrangement. Oxide rods possess significant potential for future development. (H.B.G.)

52922 BRAV: A CALCULATION PROGRAM FOR THE DESIGN OF FAST REACTOR FUEL RODS. Depisch, F.; Saelzer, H.-G. (Kernenergieversuchsanlage, Grosswelzheim, Ger.). Atomwirt., Atomtech.; 15: 439-40(Sep-Oct 1970). (In German).

The computer program BRAV intentionally avoids complex interrelationships arising from model concepts. Instead, it is based on experimental irradiation results that lead to a simplified program for engineering purposes. BRAV yields predictions about behavior of fuel rods as dependent on operation time, maximal linear power efficiency along the rod, and optimum plenum volume. A flow chart of the computer program is given as well as some test results. (H.B.G.)

52923 PRODUCTION OF FUEL ELEMENTS FOR POWER REACTORS. PRESENT STATE IN GERMANY. Ortmayer, R. M. (Reaktor-Brennelemente GmbH, Wolfgang, Ger.). VDI (Ver. Deut. Ing.) Z.; 112: 169-71(Feb 1970). (In German).

A general survey is given of the market development and the construction of power reactors including the projects of the Third Atomic Power Program. The activities of the industry to increase the fabrication capacity for fuel elements, particularly for light water reactors, and to rationalize methods and supervisions are described briefly. 15 references. (INIS)

52924 FUEL ELEMENTS FOR GAS COOLED REACTORS. Thorn, J. D.; Waddams, J. A.; Winkenbach, H. BBC-Nachr.; 52: No. 1-2, 22-5(1970). (In German).

The AGR (Advanced Gas Cooled Reactor) fuel element and fuel element cluster developed by the UKAEA are described. Operating experience since 1962 in the Windscale AGR and fuel development aspects are discussed. (INIS)

52925 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Neilson, Thomas Christopher (to United Kingdom Atomic Energy Authority). British Patent 1,208,058. 7 Oct 1970. Filed 20 Sep 1968.

Reference is made to fuel elements linked together to form a stringer prior to loading into a reactor. In pressurised gas cooled reactors if on-power refuelling is carried out difficulties may be encountered in charging the fuel stringers, in particular, vibration of the stringer may occur with risk of damage to the stringer and to reactor parts. The fuel element stringer described has at its lower end a tubular collet having resilient tines. The collet serves to restrain the bottom end of the stringer and to cut off or throttle coolant flow between the stringer and the charging guide. The dimensions of the collet are such that its leading edge guides the stringer into the charging guide, and as the collet enters the guide the tines or fingers are pushed together to reduce leakage path between the tines. (UK)

52926 DETERMINATION OF NUCLEAR FUEL BURNUP FROM FISSION PRODUCT ANALYSIS. Lisman, F. L.; Maeck, W. J.; Rein, J. E. (Idaho Nuclear Corp., Idaho Falls). Nucl. Sci. Eng.; 42: 215-19(Nov 1970).

Based on an examination of thermal and fast reactor fission yield data, specific fission products are recommended as burnup

monitors for total fissions in various reactor fuel types and for fractional fissions in $^{235}U-^{239}Pu$ and $^{233}U-^{235}U$ reactor fuels. Emphasis is placed on long-lived and stable fission products determined by mass spectrometry. The types of monitors include a single fission product for total fissions and the ratio of two fission product isotopes of the same element both for total fissions and fractional fissions. (auth)

Auxiliary and Emergency Systems

Refer also to abstract 52951.

52927 (DP-Report-218) REMOTE CONTROLLED VIEWING FOR THE DRAGON REACTOR MAIN PRESSURE VESSEL. Project DRAGON. Ritchie, D. S.; Pratt, S. J.; Barr, W. (Barr and Stroud Ltd., Glasgow (Scotland). Barr and Stroud Ltd., London (England). Atomic Energy Establishment, Winfrith (England)). Oct 1963. 23p. (CONF-631012-12). Dep. NTIS.

From Dragon Project Engineering Symposium, Bournemouth, Eng.

A remote viewing system is described which consists of an optical periscope protruding into the reactor chamber which is remotely operated by electrical means and which forms an image on a television camera placed far enough away from the reactor to be protected from the effects of temperature and radiation. Parts which may require replacement such as the illuminating lamps and the television camera are placed in a secondary containment within the primary containment, nevertheless these components should have a minimum maintenance period of two years. (auth)

52928 (DP-Report-228) THE FISSION PRODUCT DELAY BEDS FOR THE DRAGON REACTOR EXPERIMENT. Project DRAGON. Roels, H.; Fijenoord, Wiltcn (Atomic Energy Establishment, Winfrith (England)). Oct 1963. 19p. (CONF-631012-6). Dep. NTIS.

From Dragon Project Engineering Symposium, Bournemouth, Eng.

The construction and testing of the main fission product delay beds are described. These units are water-cooled, double-contained charcoal adsorption beds. Design pressure is 350 lb/in^2 absolute and design temperature 350°C. (auth)

52929 (DP-Report-257) THE GAS SAMPLING AND ANALYSIS SYSTEM OF THE DRAGON REACTOR EXPERIMENT. Project DRAGON. Enzmann, H. F. (Atomic Energy Establishment, Winfrith (England)). Jan 1964. 50p. (CONF-631012-5). Dep. NTIS.

From Dragon Project Engineering Symposium, Bournemouth, Eng.

The causes for the presence of chemical impurities in the primary He coolant and the reasons and means for their chemical analysis as parts per million concentration are described. The installation includes trace heated sample collecting pipework, manifold system, purging facilities, contained analytical instruments, an external sampling facility for removal of undiluted active gas samples, sample concentration device, and sample disposal. (auth)

52930 (LA-4458) SMOOTHING EFFECTS OF SURFACE TENSION ON GROOVED MELT WIRES. Thamer, B. J. (Los Alamos Scientific Lab., N. Mex.). May 1970. Contract W-7405-eng-36. 11p. Dep. NTIS.

Possible interference of scratch smoothing in detecting melting of cylindrical, grooved melt wires has been investigated theoretically and experimentally. Isotropy has been assumed for surface tension and diffusion coefficients. The rate of diagonal build-up of material in the bottom corner of the groove below the melting point has been calculated from known transport processes. The higher-order terms omitted in Mullins' original treatment of scratch smoothing have been retained in solving the differential equation by the method of finite differences. Other methods of solution also are discussed. The time required to give objectionable build-up (>1 mil) is calculated to be 2 days for vacuum-sealed zinc, 3 months for vacuum-sealed silver, 8 months for copper encased in graphite, 4 yr for nickel in graphite, and 5 months for platinum in graphite. The calculation is supported by experimental observations for silver. (46 references) (auth)

52931 DETECTION OF WATER PENETRATION INTO SODIUM. Subbotin, V. I.; Kozlov, F. A.; Kuznetsov, E. K.; Sergeev, G. P. (Inst. of Physics and Power Obninsk, USSR). pp 471-88 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970). (In Russian).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The detection of water penetration into Na as a result of minor steam-generator leaks is described. Reasons are given for selecting control methods based on the concentration of H_2 in the Na and in the gas cavity of the steam generator. The practical advantages and the necessity of using the two control methods simultaneously are emphasized. Analytical expressions are given for calculating variations in the concentration of H_2 in the Na and in the protective gas under various operating conditions. It is shown that the distribution of H_2 between the Na and the gas cavity of the steam generator depends mainly on the nature and site of the leak and on the temperature and hydrodynamic regime of the steam generator. Results are presented of development work and tests on systems for monitoring the concentration of H_2 in the Na and the inert gas. The system for monitoring the concentration of H_2 in the Na consists of a detection device in which hydrogen diffuses from the Na through a Ni membrane into an Ar flow, an instrument assembly for the automatic maintenance of the Ar flow rate and a secondary instrument which measures the concentration of H_2 in the Ar. The concentration of H_2 in the Ar is a function of the temperature of the Na flowing through the H_2 detection device, the concentration of hydrogen in the sodium, the argon flow-rate and the design parameters of the detection device. A method of calculation for assessing the influence of these parameters on the performance of the detection device is presented. The results of trials carried out with this system are reviewed. The system for monitoring the concentration of H_2 in the gas cavity comprises a Na-vapor filter, instruments for the automatic maintenance of the gas flow through the monitoring system and instruments for measuring the concentration of H_2 and other gases in the Ar. Test results are also quoted for this system. It is shown that measurement of the concentration of H_2 in Ar is not always an effective way of detecting water penetration into Na. 4 references. (auth)

52932 FUEL-HANDLING PROBLEMS AFFECTING THE OPERATION OF SODIUM-COOLED FAST REACTORS. Cuzzaniti, M.; Santasilia, F. (Ente Nazionale per l'Energia Elettrica, Rome). pp 787-802 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The requirements of the fuel-handling system of a fast reactor are described. Because of the high fissile content of the fuel and the frequency of refueling, it is extremely important for the operator of a large electricity network, to which a certain number of Na-cooled fast reactors is connected, to be able to rely on the proper operation of the fuel-handling system. The general characteristics of the fuel-handling systems designed to date for demonstration reactors and for the first commercial reactors to be commissioned in the 1980s are reviewed. A few particular aspects of the mentioned fuel-handling systems, such as layout, system operability, component operability, safety, refueling time, and their influence on economics, are analyzed. 3 references. (auth)

52933 USE OF LEAD IN UNLOADING SYSTEMS FOR SODIUM-COOLED FACILITIES. Shirin, V. M.; Karpov, A. V.; Aristarkhov, N. N.; Efimov, I. A.; Mamaev, L. I.; Milovidov, I. V. (Inst. of Physics and Power, Obninsk, USSR). pp 823-9 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970). (In Russian).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

Experiments on the use of Pb in unloading systems for Na-cooled facilities are described. The results of determinations of the effectiveness with which the assemblies removed from the Na are washed with molten Pb and of determinations of the quantity of Na and lead remaining on the assembly surfaces after removal from the media in question are presented. The effect of the lead on the leak-tightness of the fuel assemblies when stored in baskets with lead is analyzed. It is shown that Pb does not cause a deterioration of the leak-tightness of the fuel elements in the assemblies. Results of studies on the escape through lead of gaseous fission products from fuel elements which are not leak-tight are described. It is shown that no gas escapes through solidified lead from failed fuel elements but that molten lead has virtually no restraining effect on the escape of active gas from fuel elements. (auth)

52934 USE OF NEUTRON-ABSORBING ADDITIVES IN THE COOLANT FOR SHUTTING DOWN SODIUM-COOLED FAST REACTORS. Schroeter, K. E.; Maubach, K.; Dorner, S. (Kernforschungszentrum, Karlsruhe, Ger.). pp 883-903 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

An independent shutdown system for Na-cooled reactors is discussed. The principle of operation consists of poisoning the coolant with metals soluble in Na, i.e., miscible metals. Of all the

materials considered, Li with higher ^{6}Li concentrations is most suitable. The miscibility of Li with Na is assured for the conditions of concentration if the temperature does not fall below 150°C. After the coolant has been poisoned, Li can be separated from Na by simple methods. The corrosion problems which may arise play no major part. Calculations show that even small concentrations of ^{6}Li in the coolant of a breeder reactor give rise to considerable shutdown reactivities. For the Na-cooled 300-MW(e) reactor Na2 a technical concept is described by means of which the primary cycle can be poisoned in emergencies. The main principle consists of an automatic self-dosage of the poison by a Venturi nozzle. Quick-acting Li injectors bridge the startup phase of the automatic poisoning system. 41 references. (auth)

52935 REFUELLING OF GAS-COOLED REACTORS. Symposium Held at London, 12th December 1968. Proc. Inst. Mech. Eng. (London); 183: 1-167(1968-69). (CONF-681229).

Separate abstracts are included for each of the 17 papers presented. All first generation gas-cooled reactor fuelling systems in France, Italy, Japan and U. K. are covered, together with second generation systems such as the Advanced Gas-cooled Reactor, the German "Pebble bed" reactor, and high temperature types. Details are given of both the design and the operational performance. Discussions and communications are included. (UK)

For abstracts of individual papers see: 52768–52779, and 52936–52940.

52936 DEVELOPMENT OF FUELLING SYSTEMS FOR GAS-COOLED REACTORS. Gibbs, K. P.; Weaving, A. H. (Central Electricity Generating Board, London). Proc. Inst. Mech. Eng. (London); 183: 1-7(1968-69).

From Symposium on Refueling of Gas-Cooled Reactors, London, England. See CONF-681229.

The development of fuelling systems for the gas-cooled power reactors in the U. K. is discussed from the standpoint of the principal customer, the U. K. Central Electricity Generating Board. Emphasis is on the developing philosophies of the various designs for the Magnox power stations (from Bradwell and Berkeley to Wylfa) and for the new A.G.R. power stations (Dungeness "B" and Hinkley Point "B"). (auth) (UK)

52937 DRAGON REACTOR FUEL-HANDLING EQUIPMENT. Kinkead, A. N.; Smith, P. C. (Atomic Energy Establishment, Winfrith, Eng.). Proc. Inst. Mech. Eng. (London); 183: 8-18 (1968-69).

From Symposium on Refueling of Gas-Cooled Reactors, London, England. See CONF-681229.

The fuel-handling equipment for the Dragon reactor experiment has presented some unusual engineering problems because its design was completed in advance of that for any similar equipment on other reactors using helium as coolant. The adoption of a built-in charge/discharge machine has facilitated access to the core for removal and replacement of fuel element designs during off-load refuelling periods. The general scheme for fuel charging is outlined and reasons are given for special measures specified initially with the aim of ensuring functional uniformity combined with maximum reliability. The charge/discharge machine is described in some detail as one of the unique features in the fuel cycle system. Component development testing is mentioned and a report is given of operational experience with the equipment over a period of four years. (auth) (UK)

52938 REFUELLING EXPERIENCE ON THE CHINON POWER REACTORS. Mizzi, E. (Electricite de France, Clamart). Proc. Inst. Mech. Eng. (London); 183: 84-90(1968-69).

From Symposium on Refueling of Gas-Cooled Reactors, London, England. See CONF-681229.

The problems associated with the fuel-handling equipment for the reactors EDF 2 and EDF 3 at Chinon are discussed. Some interesting experiments which have been carried out are described. (auth) (UK)

52939 PROPOSALS FOR ADVANCED GAS-COOLED REACTOR REFUELLING MACHINERY. Lawson, D. S. (English Electric Co. Ltd., Whetstone, Eng.). Proc. Inst. Mech. Eng. (London); 183: 109-15(1968-69).

From Symposium on Refueling of Gas-Cooled Reactors, London, England. See CONF-681229.

Careful consideration of the requirements for an A.G.R. fuelling system led to the adoption of a fuelling machine capable of handling a single fuel assembly and a short shielded sealing plug. Examination of active handling and maintenance led to a combination of several functions in one facility in order to save cost. Dry storage of irradiated fuel is preferable to storage in a pond. (auth) (UK)

52940 ON-LOAD FUELING OF PEBBLE-BED HIGH TEMPERATURE REACTORS. Cleve, U.; Handel, H.; Scholz, U. (Brown Boveri/Krupp, Mannheim, Ger.). Proc. Inst. Mech. Eng. (London); 183: 124-30(1968-69).

From Symposium on Refueling of Gas-Cooled Reactors, London, England. See CONF-681229.

The essential operating functions of the fuel handling facility for this type of reactor are as follows: feeding of the spherical fuel elements, including testing, storage and charging of new fuel elements; continuous circulation of fuel elements, including discharge from the core and separation of damaged elements; measurement of burn-up and recirculation of the fuel elements, including distribution of elements to different zones of the core; discharge of burnt-up elements; and transport and storage of irradiated fuel elements for subsequent reprocessing. These various functions are described in detail, and a detailed description of the fuel handling facility is given. No major failures have occurred and there has been no evidence of broken or damaged fuel elements; it is considered that this system of refuelling a reactor with spherical fuel elements is highly satisfactory for graphite moderated and helium gas cooled reactors and ensures uncomplicated, safe, and continuous operation of the reactor with a high degree of plant availability. (UK)

52941 IMPROVEMENTS IN OR RELATING TO GAS-COOLED NUCLEAR REACTORS. Neilson, Thomas Christopher (to United Kingdom Atomic Energy Authority). British Patent 1,208,176. 7 Oct 1970. Filed 23 Sep 1968.

In conventional arrangements if on-power refuelling is carried out the gas flow in a fuel channel from which fuel elements have been discharged is increased and difficulties can arise in charging a stringer of linked fuel elements into the fuel channel through the standpipe and charging guide; the high rate of coolant flow and the flow splitting as the end of the stringer passes the gas outlets in the guide can cause the stringer to vibrate, with the possibility of damage to the stringer or parts of the reactor. In the system described the charging guide comprises a tube of wire mesh or flexible perforated metal sheet construction. The internal surface of this guide may be roughened to dissipate the jet of gas emerging from a fuel channel, and the roughening may be effected by rod material formed into a spiral or a series of spaced hoops mounted on the inside of the wire mesh. The spacing between hoops should be at least seven times the diameter of the rod material, which may be of circular or rectangular cross-section. (UK)

52942 IMPROVEMENTS RELATING TO GRAPHITE MODERATOR STRUCTURES FOR NUCLEAR REACTORS. Lind, Robert; Prince, Norman; Williams, Derek (to United Kingdom Atomic Energy Authority). British Patent 1,207,982. 7 Oct 1970. Filed 28 Feb 1967.

Reference is made to gas-cooled reactors. In the system described the moderator comprises graphite bricks and is provided with means inducing coolant flowing through fuel-free channels to diffuse through the bricks between these channels. This means may comprise flow restrictors in the coolant flow paths, whereby a pressure drop is created across individual graphite bricks, with gas seals between the bricks. In highly rated CO_2 cooled reactors, employing CO_2-graphite reaction inhibitors, it is considered that reaction may occur preferentially in the interior of the bricks, where the concentration of inhibitor is likely to be reduced. By providing means for inducing diffusion of the coolant into the bricks the extent to which the additive reaches the interior of the bricks is expected to be increased. The moderator structure may comprise stacks of graphite bricks arranged in columns, each brick having a longitudinal bore registering with the bores of adjacent bricks to provide longitudinal fuel element channels, with each brick end face having, surrounding the bore, an annular plane continuous surface abutting a similar surface of an adjacent brick. Radial keying means are disposed in the annuli between the surfaces and the periphery of each brick end. Various designs of keying and sealing are described. Rocking means may also be provided for the bricks. (UK)

52943 IMPROVEMENTS IN OR RELATING TO FUEL HANDLING ARRANGEMENTS FOR NUCLEAR REACTORS. Hopkins, Shirley Russell (to United Kingdom Atomic Energy Authority). British Patent 1,027,569. 7 Oct 1970. Filed 26 Sep 1968.

Reference is made to fuel handling arrangements for sodium cooled fast breeder reactors employing bucket-engaging grabs. The object of the system described is to provide equipment ensuring that recovery of a free-falling grab is simplified. The reactor is provided with a straight-lift grab which operates for part of its travel within a channel which terminates short of the

required fuel element position in or adjacent to the reactor core, and an extension tube is provided slidable within the grab channel so as to extend the channel to the required position. By co-operation means on the extension tube and on the grab, lowering of the grab also lowers the tube relative to the channel to the required position, at which the tube becomes independently supported, allowing the grab to move further downward relative to the tube. At a predetermined position during raising of the grab, the grab and tube are coupled and further raising of the grab also raises the tube. Extension of the channel serves to confine the grab should it become parted from its hoisting means and prevents it from being lost sideways out of alignment with the channel. Recovery of the grab can be effected within the extended bore of the channel. (UK)

Operation and Economics

52944 (ANL/EBR-13) OPERATION OF EBR-II AT 62.5 MWt: AN EVALUATION OF PLANT AND REACTOR DATA FROM RUN 38A. Cushman, R. A. (Argonne National Lab., Ill. Argonne National Lab., Idaho Falls, Idaho). Dec 1969. Contract W-31-109-eng-38. 45p. Dep. NTIS.

During run 38A (September 14 to 28, 1969) the power level of EBR-II was increased in steps from 50 to 56 to 62.5 MW(t) in accordance with the proposal for 62.5 MW(t) operation. All reactor and plant components operated in a satisfactory manner. Operation was returned to the 50 MW(t) power level for an interim period to permit modification of existing experimental subassemblies and design of future experiments for 62.5 MW(t) operation. (auth)

52945 (DP-Report-286) THORIUM URANIUM FUEL CYCLES IN LARGE H.T.G.R. Project DRAGON. Schloesser, J. (Atomic Energy Establishment, Winfrith (England)). Jun 1964. 13p. (CONF-640421-2). Dep. NTIS.

From Symposium on the Assessment Studies for a H.T.G.R., Bournemouth, Eng.

The optimization of the thorium–uranium fuel cycle in a high temperature reactor is considered from the physics point of view. Three important aspects which are discussed are: (1) recycled fuel versus once-through cycle; (2) discontinuous versus continuous reloading; and (3) power shape factors. Because of the expected high specific costs of reprocessing spent fuel in small plants high temperature reactors are expected to run more economically on a throwaway cycle until a greater number of nuclear power plants have been installed. It is concluded that an annual refuelling of one-quarter or one-sixth of the core is a good compromise between a complete core replacement and a frequent charge/discharge. (auth)

52946 SOME ASPECTS OF THE FUEL MANAGEMENT IN A NUCLEAR REACTOR. Mostert, P. (Keuring van Electrotechnische Materialen N. V., Arnhem, Netherlands). Ingenieur (Utrecht); 82: E141-5(25 Sep 1970). (In Dutch).

In a nuclear reactor, the kWh costs are partly investment and partly fuel cycle costs. The variable fuel cycle costs depend on a number of parameters which can be chosen by the operator. During the fuel design the burnup can be optimized by varying the enrichment of the fuel. During operation the determining factors are: the size of the reload batches, the frequency of reloading, the power distribution, and the specific power. The influence of each of these parameters is discussed. (auth) (NE)

Safety and Siting

52947 (EUR-4467) TREATMENT GIVEN TO SOME SPECIFIC TECHNICAL PROBLEMS IN SAFETY REVIEWS IN EUROPE. Vinck, W. (European Communities, Brussels (Belgium). Commission); Karwat, H. (Technische Hochschule, Munich (West Germany). Institut fuer Mess- und Regelungstechnik); Maurer, H. (European Communities, Brussels (Belgium). Commission). Revised 25 Jun 1969. 34p. (CONF-681101-46). Dep. CFSTI (U. S. Sales Only). EUR FF 5.60.

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C.

Some specific technical questions which have been taken up during safety analyses of power reactor projects of the water-cooled type are discussed. These safety analyses were conducted under the auspices of the European Commission jointly with a number of specialized organizations from within the Member States, at the request of or in agreement with the relevant national authorities. The specific technical topics dealt with are defined, and the techniques used for their handling, independently from the constructors, are critically described. The following examples are treated: (1) Blowdown of primary system; (2) Protection against reactivity excursions; (3) Possible assessment of pressure vessel internals resistance against fatigue; and (4) Examples of system analysis. 12 references. (auth)

52948 (EURFNR-814) ADVANCED STATISTICAL HOT SPOT ANALYSIS. Amendola, A. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Mar 1970. 125p. (KFK-1134; EUR-3687). Dep. NTIS (U. S. Sales Only).

Work performed under United States–Euratom Fast Reactor Exchange Program.

A general statistical method of hot spot and hot channel analysis is presented. A definition of "hot spot" is proposed, which allows the correlation of the probability of exceeding certain critical temperatures to the size of the zone in which they occur. The assumptions of previous methods are reviewed and, in contrast to results of previous methods, the hot channel factors are demonstrated to be independent of the assumed spot size. The different effects of local and global uncertainties, and the radial and axial power profile in the core are taken into account. Together with the probability of at least one hot spot in the core, the probability that hot spots occur in exactly one, or exactly two, or in exactly n subassemblies is evaluated. A description of the FORTRAN-4 code SHOSPA, which is based on the proposed method and is applicable to any type of reactor and any power profile as long as the core is constituted of bundled fuel rods, is presented. A numerical application of the code to the sodium cooled fast reactor Na-2 is shown, together with the analysis of the influence of the assumed spot size on the hot spot factors. 17 references. (auth)

52949 (EURFNR-816) THE BEHAVIOUR OF NUCLEAR AEROSOLS IN CLOSED SYSTEMS. Specialist Meeting at the Nuclear Research Center, Karlsruhe on November 11 and 12, 1969. Schikarski, W. (comp.) (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Jun 1970. 67p. (KFK-1206; CONF-691113).

Work performed under United States–Euratom Fast Reactor Exchange Program.

Theoretical and experimental results, the discussion of the mechanism and processes involved in the behavior of aerosols and the discussion of the various experimental and instrumental techniques used by different research groups are presented. The application of the results on the problem of activity release during heavy accidents in fast sodium cooled reactors is reviewed with some bearing on the problems of other nuclear reactor types. (auth)

52950 (LIB/Trans-304) EVALUATION OF THE VOLATILE RADIOACTIVE RELEASES FROM NUCLEAR INSTALLATIONS FOR VARIOUS OPERATIONAL CONDITIONS. Schimmel, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Translated by I. A. Mumme for Australian Atomic Energy Commission Research Establishment, Lucas Heights), from report SZS-15/69. 14p. Dep. NTIS (U. S. Sales Only).

The volatile radioactive releases from nuclear installations are analyzed. The fundamental way of accident analysis is outlined for an incident caused by a large loss of coolant. The consequences for the installation as well as the environment are shown. (7 references.) (auth)

52951 (ORNL-TM-3122) ORNL NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROGRAM BIMONTHLY REPORT FOR JULY–AUGUST 1970. Cottrell, Wm. B. (Oak Ridge National Lab., Tenn.). Oct 1970. Contract W-7405-eng-26. 152p. Dep. NTIS.

The accomplishments during the months of July and August in the research and development program under way at ORNL as part of the U.S. Atomic Energy Commission's Nuclear Safety Program are summarized. Much of this work is in general support of water-cooled power reactor technology, including LOFT and industry programs, and reflects current safety problems, such as measurements of prompt fuel element failure phenomena and the efficacy of containment-spray and filter systems for the removal of accident-released fission products and aerosols from gas streams. Several projects are also conducted in support of the high-temperature gas-cooled reactor (HTGR) and liquid-metal fast breeder reactor (LMFBR) programs. Other major projects include studies of primary piping, steel pressure-vessel technology, and seismic design consideration. Experimental work relative to pressure-vessel technology includes investigations of the attachment of nozzles to shells and the implementation of joint AEC–PVRC programs on heavy-section steel technology and nuclear piping, pumps, and valves. Several of the projects are directly related to the AEC's standards program, which entails development of engineering safeguards and the establishment of codes and stan-

dards for government-owned or -sponsored reactor facilities. The recent activities of NSIC and the Nuclear Safety journal in behalf of the nuclear community are also discussed. Of particular interest in both of these activities is the recent emphasis on environmental effects. (auth)

52952 REACTOR SAFETY IN THE FEDERAL REPUBLIC OF GERMANY. Birkhofer, A. (Technische Hochschule, Munich); Braun, W.; Koch, E. H.; Kellermann, O.; Lindackers, K. H.; Smidt, D. Atomwirt., Atomtech.; 15: 441-8(Sep-Oct 1970). (In German).

At the present point of technical development and reactor safety, no principal objections exist against construction of large-scale nuclear power stations of the light water type in West Germany. Safety analysis, based on the most pessimistic hypothetical failure, is sufficiently sound to ensure security to the environment. A system for compiling all incidents is proposed as well as further experimental and analytical studies concerning the efficiency of safety installations. In addition, achievement of optimal safety must be further examined with respect to redundancy and diversity. Procedures for reactor permits are being improved; thus far, no serious conflicts exist between interests of the public and those of the builder or the operator. (tr-auth)

Power Conversion Systems

52953 (DP-Report-222) EXPERIMENTAL WORK ON GASEOUS AND BOILING HEAT TRANSFER ASSOCIATED WITH THE DESIGN OF THE DRAGON PRIMARY HEAT EXCHANGERS AND SOME ASPECTS OF THEIR MANUFACTURE. Project DRAGON. Gilli, P. V. (Waagner-Biro A. G., Vienna (Austria). Atomic Energy Establishment, Winfrith (England)). Oct 1963. 60p. (CONF-631012-7). Dep. NTIS.

From Dragon Project Engineering Symposium, Bournemouth, Eng.

After a concise review of design principles and data of the Dragon primary heat exchangers, selected aspects of their manufacture, assembling under clean conditions and workshop testing are discussed. Experimental work performed under participation of Dragon Project to establish the gas-side heat transfer characteristics of the concentric multistart helicoil tube bundles is reviewed and evaluated. Further, experimental work in the field of boiling heat transfer, including film boiling (burn-out) studies under the working conditions of the Dragon Reactor, is described and an outline is given of present and planned future work in this field under conditions of the Dragon Reactor Experiment and of large High Temperature Gas Cooled Reactors. 36 references. (auth)

52954 HIGH-POWER TEST LOOP FOR SODIUM-HEATED STEAM GENERATORS. Milliat, J.-P. (Electricite de France, Chatou); Beaufrere, J.; Lecocq, P.; Chauvin, M. pp 55-72 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970). (In French).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

Within the framework of the development studies being carried out on sodium-cooled breeder reactors, a test rig capable of supplying sodium to steam generators of industrial size is designed and tested. It was felt that this research should make it possible to solve most of the problems presented by the high-power steam generators that are to be used with reactors of this type. The test loop is located at the Renardières site. It consists of a sodium circuit, a water-steam circuit equipped with a condenser cooling circuit, and a control console from which these circuits are operated. Design parameters are listed. 6 references. (auth)

52955 CHOICE OF STEAM CYCLE FOR A SODIUM-COOLED REACTOR. de Boer, G. A.; de Hes, M. (N. V. Neratoom, The Hague). pp 703-13 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The use of Na-heated reheaters yields complicated Na-piping systems which are expensive. The adoption of a straight steam cycle gives simplifications in the Na systems. The alternatives for a steam cycle with Na-heated reheaters i.e. reheat with live or expanded steam and straight expansion with moisture separation outside or inside the turbine were studied. For each cycle the most important design parameters: throttle steam pressure, reheat temperature, pressure drop in reheater or moisture separator were varied to find the optimum cycle conditions. The net thermal efficiency was calculated for each steam cycle; seven or eight regenerative feedwater preheaters were used and the power consumption of the electrical feed pump was taken into account. Live-steam reheat cycles have a ¼% lower efficiency than Na reheat cycles. The maximum reheat temperature is limited to about 430°C for a steam throttle pressure of 165 bars. Expanded steam reheat can yield a higher cycle efficiency than Na reheat. However, this occurs only at a relatively low reheat temperature. Straight expansion has a 1% lower efficiency than Na reheat independent of steam throttle conditions. Moisture separation inside the turbine gives a further decrease of the efficiency by 0.1%. Due to the pressure drop in the moisture separator by using an external moisture separator there is a 0.5% lower efficiency as compared to straight expansion. After choosing the optimum steam cycle for each of the above mentioned cases an economic evaluation was made using the kWh price as basis of comparison. 10 references. (auth)

Research and Test Reactors

Refer also to abstracts 52374, 52746, 52850, 52891, 52892, 52917, 52920, and 52997.

52956 (ANL/EBR-12) PROPOSAL FOR OPERATING EBR-II AT 62.5 MWt. (Argonne National Lab., Ill. Argonne National Lab., Idaho Falls, Idaho). Aug 1969. Contract W-31-109-eng-38. 67p. Dep. CFSTI.

The benefits of increasing the power level of EBR-II from 50 MW(t) to 62.5 MW(t) have been determined. A two-stage plan for increasing the power to 62.5 MW(t) is presented. The first stage calls for operation at 56 MW(t) for about two days and then 62.5 MW(t) for about eight days with the experimental subassemblies removed from the core; the second stage calls for continual operation with experimental subassemblies at 62.5 MW(t) after six months of operation at 50 MW(t), which will give experimenters time to plan for routine 62.5 MW(t) operation. Conditions in the reactor and plant have been predicted, and no conditions are foreseen that would preclude successful operation at 62.5 MW(t). 10 references. (auth)

52957 (BNWL-1165) ESTABLISHMENT OF THE FFTF VERTICAL CORE REFERENCE CONCEPT. Cabell, C. P. (comp.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sep 1970. Contract AT(45-1)-1830. 139p. Dep. NTIS.

A review of the conceptual design studies for the FTR core is presented. The interim reference concept and the split conical core designs are reviewed. The vertical core reference concept is described. Design parameters and drawings of the vertical core reference concept are presented. Other reactor systems described include: control rod drives, test facilities, loading machines, and instrumentation. (D.C.C.)

52958 (BNWL-1430) METAL SWELLING AND IRRADIATION CREEP EFFECTS UPON THE FAST TEST REACTOR CORE COMPONENT PERFORMANCE. Jackson, R. J.; Sutherland, W. H.; Metcalf, I. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sep 1970. Contracts AT(45-1)-1830; AT(45-1)-2170. 53p. Dep. NTIS.

An analysis has been performed which predicts the bending distortion in fast reactor core components. It is shown that thermal strains, swelling strains, and irradiation creep strains are all important at some time during the lifetime of these components. It is concluded that irradiation creep greatly ameliorates the bending distortions of these core components. 8 references. (auth)

52959 (BNWL-1504) PRELIMINARY DESIGN FOR A PHOENIX FUELED HFIR REACTOR. Jenquin, U. P. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sep 1970. Contract AT(45-1)-1830. 48p. Dep. NTIS.

Calculations were performed to determine potential advantages of utilizing Phoenix fuel for the High Flux Isotope Reactor (HFIR). The Phoenix Fuel Program, under which this study was performed, is a research and development project concerned with the use of plutonium fueled systems for extending core reactivity lifetime. The neutronic characteristics of a plutonium fueled HFIR are compared to a uranium fueled HFIR. Utilizing the results of the neutronic investigations, a preliminary plutonium fueled HFIR design is derived. (18 references) (auth)

52960 (EUR-4451) THE OPERATIONS GROUP OF THE BR-2 REACTOR AND ITS ASSOCIATED FACILITIES. Annual Progress Report, 1967. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 20 Dec 1968. 40p. Dep. CFSTI (U. S. Sales Only). EUR FF 6.65.

The principal experiments made are reviewed, not only for the fast, the gas cooled, the light water, and the homogeneous reactor systems, but also in the field of fundamental research on fissile materials and structural materials. Some 186 devices were irradiated during the year, not counting standard isotope cans or measuring devices. On average, 39 reactor channels were occupied. During the second half of the year, 3 large loops were operated simultaneously and almost continually. A particularly noteworthy feature was the power-cycling carried out in one of these loops, achieved by the motion of a special control rod placed in a neighboring channel. The reactor was operated for 174 days at its nominal power between 57 and 63 MW. In addition, several special campaigns of irradiation were carried out. During one of these, the reactor power was raised to the exceptional level of 73 MW. Operating incidents were far fewer than in previous years, involving a loss of running time of only 4.7 days, as against 21.6 in 1966. Significant extensions to all shut downs occurred in the second half of the year, due to the alpha contamination arising from a faulty americium capsule, which completely immobilized the reactor for 60 days. Fuel consumption was maintained at a particularly low level. The average burn-up level of the fuel elements over the year was 36.2%. Several additions were made to the installations to meet the needs of the experimentalists. An order has been placed for a new dismantling machine for active rigs, and a start has been made on the modifications to the hot-cells needed for the actinium program. 13 references. (auth)

52961 (KFK-1141) MEASUREMENT OF THE ENERGY AND SPATIAL DEPENDENCE OF NEUTRON INFLUENCE FUNCTIONS IN THE FAST CRITICAL ZERO-ENERGY ARRANGEMENT. Korthaus, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). May 1970. 107p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Karlsruhe Univ., Ger.

Measurements of the energy and spatial dependence of neutron importance in the SNEAK-assemblies 3A-2 and 3B-2 are reported, as well as the determination of the energy spectra and intensities of the neutron sources used for the measurements. The importance measurements are compared with multigroup calculations. The various measuring methods are described in detail. The mathematical properties of the importance function and some aspects of its numerical calculation are discussed. 62 references. (auth)

52962 (ORNL-TM-2893(Vol.1)) TOWER SHIELDING REACTOR II DESIGN AND OPERATION REPORT. VOL. 1. DESCRIPTION. Holland, L. B. (Oak Ridge National Lab., Tenn.). 7 Oct 1970. Contract W-7405-eng-26. 97p. Dep. NTIS.

The operating history of the TSR-2 is reviewed. The reactor site and facilities are described. Design parameters of the reactor components and systems are presented. Heat transfer and physics measurements are included. Instrumentation is described. (D.C.C.)

52963 (ORNL-TM-2893(Vol.2)) TOWER SHIELDING REACTOR II DESIGN AND OPERATION REPORT: VOL. 2. SAFETY ANALYSIS. Holland, L. B.; Kolb, J. O. (Oak Ridge National Lab., Tenn.). 7 Oct 1970. 112p. Dep. NTIS.

The Tower Shielding Reactor II is a spherically symmetrical experimental reactor that was installed at the Tower Shielding Facility in 1960. It is proposed that the TSR-II be operated at a power level of 1 MW with the three following limitations: (1) the core life will be limited to 3000 MWhr, (2) continuous operation at 1 MW will be limited to periods of 75 hr or less, and (3) operation at a power level of 1 MW will be initiated only if the afterheat from previous operation has decayed to a sufficiently low value. The factors considered in the safety analysis for operation at the proposed power level of 1 MW were the lack of a containment barrier around the primary core coolant system, the operation of the reactor while suspended from the TSF towers, and the minimum exclusion distance of 4085 ft from the reactor to the nearest point of public access at the general exclusion fence. The investigation was directed primarily to the adequacy of the fuel plate cladding as a barrier to fission-product release and to the amount of fission-product release that could be tolerated under the Maximum Credible Accident conditions. (auth)

52964 (WHAN-FR-23) USERS' GUIDE FOR THE IRRADIATION OF EXPERIMENTS IN THE FTR. Preliminary Report. Schively, D. P. (WADCO Corp., Richland, Wash.). Sep 1970. Contracts AT(45-1)-1830; AT(45-1)-2170. 100p. Dep. NTIS.

A preliminary guide has been prepared to assist in the definition and plans for the initial in-reactor irradiation experiments in the FTR. The capabilities and unique requirements of the FTR are detailed in the format of the "Users' Guide for EBR-II." Appendixes present specific safety and geometry for test experiments. Sample experiments are described. (auth)

52965 AVAILABILITY OF RAPSODIE COMPONENTS FROM 30 AUGUST 1967 UNTIL 30 NOVEMBER 1969. Delisle, J. P.; Valantin, M. (CEN, Cadarache, France). pp 3-18 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970). (In French).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The operation of RAPSODIE is supplying numerous data on the availability of components for sodium-cooled reactors. From the start of the first irradiation campaign on August 30, 1967 until November 30, 1969 the load factor of RAPSODIE has been 61.2%, and availability during irradiation campaigns has been 92.5%. The longest period of continuous operation at power has been 33 days. Causes of lack of availability and of incidents, and the remedies which have been applied, are examined. (auth)

52966 SEFOR: SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Broom, K. M. (Middle South Services Inc., New Orleans); Mitchell, S. L. pp 33-40 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The Southwest Experimental Fast Oxide Reactor (SEFOR) is a 20-MW(t) plutonium-uranium mixed oxide fuelled sodium-cooled reactor. The initial chain reaction was achieved on 3 May 1969. Since achieving initial criticality, the reactor has operated under a 1-MW(t) licence. An extensive zero- and low-power test program is proceeding according to contract schedule and issuance of the 20-MW(t) operating licence is expected in the near future. A primary purpose of the SEFOR program is to investigate experimentally the Doppler effect as an inherent safety feature of a mixed oxide-fuelled fast reactor. Other safety related investigations are also being carried out. Results of the present program, problems encountered in design, construction and operation, and future plans for utilization of the facility are described. (auth)

52967 EBR-II FUEL HANDLING SYSTEM. Cerutti, B. C.; Deegan, G. E.; Hutter, E.; Waldo, J. B. (Argonne National Lab., Idaho Falls, Idaho). pp 739-55 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

Experimental Breeder Reactor II (EBR-II) is an unmoderated, Na-cooled reactor with a design power level of 62.5 MW(t). The design is a submerged pool concept, the reactor and fuel-handling components being contained in a primary tank filled with Na. Fuel-handling requirements have increased considerably since emphasis shifted to the use of EBR-II as an irradiation facility. Core changes were made which allowed more experimental sub-assemblies to be accommodated in the reactor. Many other sub-assembly transfers were necessary while investigating the physics characteristics of the reactor core. As a result, the number of fuel transfers to date has far exceeded the original design criteria. By October 1969, 3628 unrestricted, 1829 restricted, and 658 special sub-assembly transfers had been made. Performance of the fuel-handling system has generally been very good, considering the experimental nature of the equipment and the environment in which it must operate. During initial check-out and operation of the equipment, several problems were encountered. A continuing effort to resolve these problems has resulted in component redesign and modifications to upgrade system performance and reliability. The EBR-II fuel-handling component design and operating experience can in many cases be applied to the design of future large fast reactors. 7 references. (auth)

52968 FFTF REACTOR REFUELLING SYSTEM. Cockeram, D. J. (Atomics International, Canoga Park, Calif.); Halpine, P. A. Contract AT(04-3)-701. pp 803-21 of Sodium-Cooled Fast Reactor Engineering. Vienna; International Atomic Energy Agency (1970).

From Symposium on Progress in Sodium-Cooled Fast Reactor Engineering, Monaco. See STI/PUB-256; CONF-700307.

The inclusion of experimental facilities and requirements in this reactor have led to unique problems and solutions for the driver fuel and test-assembly handling. Handling operations which occur within the containment sphere of the facility are described. The core is composed of a close-packed array of hexagonal driver fuel elements with interspersed control/safety rods and test positions. The test positions are of open-loop (utilizing reactor coolant) and closed-loop types, both of which have vertical extensions from the core through the top shield of the reactor. Peripheral in-vessel storage positions are provided for driver fuel. The refuelling system should be able to handle element decay powers up to 30 KW(t) without perturbing test data in the experiments. Argon gas is used in the reactor cover space and in associated devices such as fuel-handling machines. Adjacent element holddown capability of the in-

vessel fuel-handling machine is complicated by the vertically protruding test loops. There is a strong economic incentive to reduce the length of the test assemblies prior to their removal from the containment sphere for examination or dispersal. All test handling systems must be compatible with the objective for reinserting test specimens in the reactor after an interim examination. An off-set in-vessel handling machine is required to transfer driver fuel from the core to and from the interim storage positions. An ex-vessel machine transfers driver fuel from an interim decay facility within the containment to and from the in-vessel storage and it transfers tests in and out of the reactor. A loop-preparation machine is utilized to prepare the loops for handling operations. The ex-vessel machine also transfers fuel and tests between the interim decay storage and a transfer cask. The requirements for each machine and assembly of the reactor-refuelling system and the solutions that were generated are described. Trades leading to system optimization are discussed and the resulting fuel-handling system conceptual design is described. A brief description of the planned development program is presented. The applicability of the FFTF fuel-handling development is discussed with respect to the requirements of central station LMFBRs. (auth)

52969 NONDESTRUCTIVE TESTING OF ANODIZING LAYERS OF ALUMINUM FUEL ELEMENT CANS GROOVED FOR POWER INCREASE OF THE WWR-S CZECHOSLOVAK NUCLEAR REACTOR. Vozenilek, Frantisek (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ.; 16: 349-52(Oct 1970). (In Czech).

The method and results of nondestructive testing of layers formed on aluminum fuel element cans by anodizing oxidation are described. The ITO21-22 conductance meter measurements give useful and interesting results in determining the thickness unevenness of anodizing layers on the periphery of aluminum sheathing of fuel rods, further in determining the dependence of anodizing layer thickness on anodizing time, and finally in great accuracy of the absolute values of anodizing layer thickness which are very important in the corrosion protection of fuel elements. (auth)

52970 SPATIAL TRANSFER FUNCTIONS OF A TWO CORE REACTOR. Jeffers, D. E. (Univ. of Manchester, Eng.). Atomkernenergie; 16: 129-31(1970).

The spatial transfer functions of an Argonaut type reactor have been calculated using two group diffusion theory and the results compared with the values obtained in an oscillator experiment. 11 references. (auth)

52971 SPATIALLY DEPENDENT NOISE MEASUREMENTS IN A TWO ZONE REACTOR. Humphreys, E. (Universities Research Reactor, Risley, Eng.); Jeffers, D. E. Atomkernenergie; 16: 132-4(1970).

The experimental results of noise measurements on the Argonaut type reactor at Risley are presented and compared with earlier oscillator measurements. The cross power spectral density function of two detectors positioned adjacent to the two slabs of the reactor has been used to measure the coupling and the propagation time of disturbances between the two cores. 9 references. (auth)

52972 EXPONENTIAL EXPERIMENTS WITH LATTICES OF ^{233}U OXIDE AND THORIUM OXIDE IN LIGHT AND HEAVY WATER. Windsor, H. H.; Tunney, W. J.; Price, G. A. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng.; 42: 150-61(Nov 1970).

An extended series of exponential experiments was carried out utilizing $^{233}UO_2-ThO_2$ fuel elements in uniform arrays in light and heavy water. In this series the principal parameters measured were material buckling (B_m^2), reflector savings (λ), dysprosium disadvantage factor (ξ_{Dy}), ratio of epicadmium to subcadmium capture in thorium (ρ_{Th}^{28}), and ratio of ^{233}Th fission to ^{233}U fission (δ_{25}^{23}). A total of 29 clean and poisoned lattices was measured. (auth)

Rocket and Space Reactors

Refer also to abstract 50497.

52973 (N-70-25447) SOME FUEL LOSS RATE AND WEIGHT ESTIMATES OF AN OPEN-CYCLE GAS-CORE NUCLEAR ROCKET ENGINE. Ragsdale, Robert G. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). 1970. 10p. (NASA-TM-X-52775). NTIS.

An analysis is carried out to estimate engine weight and to show the effect on engine weight of engine thrust, specific impulse, and U loss rate for a gaseous fueled nuclear rocket engine. The analysis incorporates recent results from laboratory experiments on two gas mixing, and from theoretical predictions of U plasma composition and opacity. Engine weights are calculated for engine thrust ranging from 100,000 to 1,000,000 lbs, for specific impulse ranging from 1000 to 1800 sec, and for H to U flow rate ratio ranging from 25 to 200. Critical mass is treated as a parameter; values of 25, 50, and 100 kg are used. All calculations are based on a 12 ft diameter cavity that is surrounded by 120,000 lbs of moderator reflector. The total engine weight is composed of that of the moderator reflector, pressure shell, nozzle, and turbopump. It is shown that engine weight is a relatively weak function of U loss rate. (auth) (STAR)

52974 (N-70-26934) STEADY-STATE PERFORMANCE OF A SNAP-8 DOUBLE-CONTAINMENT TANTALUM-STAINLESS STEEL MERCURY BOILER. Lottig, Roy A.; Soeder, Ronald H. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Mar 1970. 64p. (NASA-TM-X-52795). NTIS.

Boiler performance mapping was performed between SNAP-8 system startup tests. The Hg boiler was a counterflow heat exchanger with double-containment, Ta and stainless steel construction. Boiler performance data obtained between early startup tests (3 through 21) indicated a boiler deconditioning (Hg side surface contamination) problem. The boiler did condition (Hg-side surface contamination removed) for later startups (34 through 135) resulting in an overall pressure drop of 183 psi for a Hg flow rate of 6600 lbm/hr and a boiler inventory of 26 pounds. At the design Hg flow rate of 12,300 lbm/hr the boiler overall pressure drop was 129 psi with a boiler inventory of 34 pounds. The boiler NaK flow rate and inlet temperature for both of the above Hg flow rates were approximately 46,000 lbm/hr and 1280°F and 45,700 lbm/hr and 1300°F, respectively. (auth) (STAR)

52975 (N-70-27200) SNAP-8 TUBE-IN-TUBE MERCURY BOILER DEVELOPMENT USING 9 PERCENT CHROMIUM-1 PERCENT MOLYBDENUM STEEL. Chalpin, E. S.; Lombard, G. L. (Aerojet-General Corp., Azusa, Calif.). Oct 1969. Contract NAS5-417. 108p. (NASA-CR-72531; AEROJET-3662). NASA, College Park, Md.

Four configurations of the NaK-to-Hg tube-in-tube boiler using 9% Cr-1% Mo steel (9M) as the Hg containment material were fabricated and tested in the SNAP-8 program. The thermal and mechanical designs as well as the performance of each boiler are described. The problems of conditioning the boilers in a Hg environment, corrosion, decarburization and concomitant or subsequent cracking of the 9M material, and the thermal stress failure of the Type 321 stainless steel boiler shell prevented these configurations from attaining the 10,000-hour life requirement. Methods of determining predictable thermal performance, fabrication techniques and the types of tests performed are presented. (auth) (STAR)

52976 (N-70-29864) STARTUP TESTING OF THE SNAP-8 POWER CONVERSION SYSTEM. Hurrell, Herbert G.; Boecker, Fred Jr.; Jefferies, Kent S. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). [1970]. 14p. (NASA-TM-X-52822). NTIS.

SNAP-8 development has included extensive startup testing of the power conversion system coupled with a reactor simulator. Data are presented that show the power conversion system can be started in a dependable way. The temperature transients are well within the limits specified for the reactor. Procedures are discussed for the relatively fast transient to self-sustained operation and for the more gradual transient that achieves rated power output. (auth) (STAR)

52977 (N-70-29993) EVALUATION OF CRITICAL MASS FOR OPEN-CYCLE, GAS-CORE ROCKET REACTORS. Hyland, Robert E. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). [nd]. (NASA-TM-X-52820; E-5707). NTIS.

A nuclear analysis using transport theory was made of an open-cycle gas-core reactor for assumed operating conditions. Calculations were made for cavity diameters from 8 to 16 feet, for hydrogen (cavity) bypass variation from 0 to 99 percent, for reflector thickness from 2 to 3.5 feet, and for both isotopes ^{235}U and ^{233}U as fuel. For these configurations the results indicated some system pressures of less than 1000 atmospheres. (auth) (STAR)

52978 (N-70-31873) DESIGN AND DEVELOPMENT OF A SNAP-8 MERCURY PUMP MOTOR ASSEMBLY. Pope, J. R.; Mah, C. S.; Foss, C. L. (Aerojet-General Corp., Azusa, Calif.). Nov 1969. Contract NAS5-417. 50p. (NASA-CR-72664; AEROJET-3665). NASA, College Park, Md.

The design and development of a Hg pump and motor for use in

the SNAP-8 Electrical Generating System while in a space environment are described. The pump, a combination jet-centrifugal type, is driven by a motor with oil-lubricated ball bearings. A dynamic, shaft seal-to-space is used to separate the mercury and the lubricant oil. A total of 6 units have been built and operated for an accumulated testing time of 22,213 hours; the longest test time on one unit was 12,227 hours. The pump was considered to be successful and exceeded the specification requirements for a 10,000 hour life. The only complications encountered were in the seal-to-space. (auth) (STAR)

52979 STATUS REPORT ON THE NERVA NUCLEAR ROCKET. Esselman, W. H.; Keller, M. R. (Westinghouse Electric International Co., New York). Atompraxis; 16: 241-5 (Jul-Aug 1970).

The potential performance capabilities of the nuclear rocket engine which greatly exceed that of chemical rocket engines are analyzed. Successful testing of several models shows that the basic technology of nuclear rocketry is ready for exploitation in the form of a NERVA flight engine. (7 references) (auth)

52980 INTERACTION OF NEUTRONICS AND ACOUSTICS IN A GASEOUS CORE NUCLEAR ROCKET. McNeill, Harry; Becker, Martin (Rensselaer Polytechnic Inst., Troy, N. Y.). Nucl. Sci. Eng.; 42: 220-9(Nov 1970).

Acoustic wave propagation in a gaseous core nuclear rocket is investigated by a theoretical model. Slab geometry in a long initially uniform cavity is assumed for simplicity and the reflector-heat sink is taken to be of infinite thickness. Blackness theory is used to determine the transmission of thermal neutrons (and thereby the generation of heat) in the fissionable gas of the cavity. Mutual feedback between neutron dynamics and gas dynamics occurs by means of the density-dependence of the blackness coefficients. Numerical results indicate that neutronic feedback can be a significant influence toward stabilization of acoustic oscillations. The critical wave length (which is twice the critical core length) without neutronic feedback is calculated to be 100 cm while critical wave lengths of 150 and 232 cm were obtained for carbon and beryllium reflectors, respectively. These results show that the critical core lengths are still comparable to or shorter than typical reference core lengths (300 cm). Thus, while neutronic feedback has an effect on acoustic instability, the effect is not strong enough to alter the general conclusion that acoustic instability is a potential problem area for gaseous reactor development. (auth)

Process Heat and Desalination Reactors

Refer also to abstract 52746.

52981 PROGRAM FOR THE INVESTIGATION AND DEVELOPMENT OF DESALINATION OF SALT AND BRACKISH WATERS. Martinez, Francisco Pascual (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 13: 206-31(May-Jun 1969). (In Spanish).

Two dual purpose plants for the desalination of water and the production of electricity are in operation in Spain. Both installations use flash distillation. Other methods of desalination— crystallization, electrolysis, inverse osmosis, solvent extraction, and ion exchange— together with other distillation methods are discussed with respect to their suitability for the particular needs of Spain. The development done on flash distillation, solar distillation, electrodialysis, and inverse osmosis is described in some detail. The study made of the feasibility of dual purpose power plants for the Almeria and Barcelona areas is summarized. The future applications of desalination plants in Spain are evaluated economically. (J.S.R.)

Marine and Portable Power Reactors

Refer also to abstracts 52746 and 52763.

52982 (AD-707453) MH-1A CORE PHYSICS TEST REPORT. Final Report. Sears, C. Frederick; Gregory, Michael V. (Army Engineer Reactors Group, Fort Belvoir, Va. Engineering Div.). 16 Mar 1970. 46p. (ED-7002). NTIS.

Core physics measurements were performed in November 1969 on the first refueled core of the MH-1A (Sturgis). The data recorded are analyzed. The basic physical parameters describing the core are derived and compared with the pre-refueling values and the theoretical values. (auth) (USGRDR)

52983 (AD-707935) SM-1A 20.3 MWYR CORE III PHYSICS TESTS REPORT. Henry III, Charles D. (Army Engineer Reactors Group, Fort Belvoir, Va. Engineering Div.). 6 Apr 1970. 72p. (ED-7005). NTIS.

The conduct and results of the 20.3 MWYR core physics tests on SM-1A Core III are discussed. The results are evaluated and compared with previous results where possible. The results are used to check the present behavior of the core, as compared to the predicted behavior, and to predict the lifetime of Core III. Various figures and tables are used to illustrate the measured results and the predicted lifetime. (auth) (USGRDR)

52984 (AEC-tr-7097) BIOLOGICAL SHIELDING OF MARITIME REACTORS. Broder, D. L.; Popkov, K. K.; Rubanov, S. M. Translation of Biologicheskaya Zashchita Sudovykh Reaktorov, Izatel'stvo Sudostroenie, Leningrad, 1964. 354p. (TT-70-50006; IPST-Cat.-5656). Dep. NTIS.

Physical principles and calculation methods used in the design of biological shields for marine reactors are presented. Topics discussed include: the interaction of radiation with matter; effects of radiation on man, and the fundamentals of dosimetry; radiation effects in materials and properties of shielding materials; sources of penetrating radiation in reactors; the influence of source geometry on the space distribution of radiation fluxes; penetration of fast neutrons; space energy distribution of neutrons in shields; calculation of γ-ray attenuation; capture γ-rays and heat release; radiation streaming through channels in shields; activation problems; radiation safety on nuclear propelled ships, and marine reactor shields. (D.C.C.)

52985 (HIT-3775-4) ADDENDUM TO PM-3A HAZARDS ANALYSIS REPORT: TYPE 4 CORE SAFETY ANALYSIS. (Hittman Associates, Inc., Columbia, Md.). Jul 1970. Contract AT(30-1)-3775. 49p. (HIT-461). Dep. NTIS.

The consequences of various incidents and the hypothetical accident are analyzed. Incidents which result in power, temperature, and pressure transients within the reactor core, but do not involve a failure of the reactor coolant system boundary, are discussed. For these incidents, the analyses show that safety margins and safeguards incorporated into the reactor design will prevent fuel damage. The incident which does involve a failure of the reactor coolant system boundary is also treated. The containment pressure analysis shows, however, that plant design features are more than adequate to limit the consequences of a major loss of coolant accident. The hypothetical accident involves a release of substantial quantities of fission products from the reactor core to the containment. This accident is not considered credible due to the numerous protective devices and systems incorporated into the plant, but it is analyzed as a measure of the most severe radiation hazard to base personnel that could conceivably occur as a result of plant operation. (3 references) (auth)

52986 OPERATING EXPERIENCE WITH PROPULSION REACTORS: THE "OTTO HAHN". Kolb, M. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.); Salander, C.; Ulken, D.; Mausbeck, H. Atomwirt., Atomtech.; 15: 459-63(Sep-Oct 1970). (In German).

The Otto Hahn is a 20,000 ton vessel with cargo space for 40,000 tons of ore. Its propulsion system consists of an advanced pressurized water reactor of 38 MW(t) corresponding to 11,000 hp mechanical which permits a speed of 17 knots. Experimental sea trials started in 1968. Since then, the vessel has covered 61,000 nautical miles. The reactor was in operation for a total time of 8,450 hours. Experiences during long voyages and under heavy weather conditions are described. Rapid ship maneuvers demanded sudden changes in reactor power from 10 to 80%. Under present conditions somewhat more than 20 seconds are required to shift the turbine power from zero to full power. Experience showed that the advanced pressurized water reactor is very suitable for ship propulsion and its ease of control makes it superior to conventional boiler systems. (H.B.G.)

Production Reactors

Refer also to abstract 52746.

Reactor Theory

52987 (WAPD-TM-942) BUBL-1: A STATISTICAL FUEL SWELLING AND FISSION GAS RELEASE MODEL. (LWBR Development Program). Warner, H. R. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Sep 1970. Contract AT(11-1)-Gen-14. 85p. Dep. NTIS.

A computer simulation of a fuel region has been developed based on movement of fission-gas bubbles in solids under a thermal gradient. Within this region, fission gas events are followed via a Monte Carlo technique. Individual bubbles are followed through their time history from nucleation to release from the fuel, with interactions at dislocations and grain boundaries. Saturation in gaseous swelling at elevated temperature is predicted. A maximum in swelling is predicted at intermediate temperatures for a given burnup. These swelling and gas release predictions at high temperatures are in good agreement with experimental results. A low temperature modification of dislocation density is required to allow for effects dominant at low temperature which are not included in the current version of the program. With this low temperature modification, swelling predictions are in good agreement with experimental observations over the entire operating temperature range. (44 references) (auth)

52988 RECENT METHODS OF BURN-UP CALCULATION IN THERMAL REACTORS. Meyer, K. (VEB Kombinat Kraftwerksanlagenbau, Berlin). Kernenergie; 13: 193-8(Jul 1970). (In German).

The essential principles of the methods of burn-up calculation in thermal reactors used at present are described. After describing the methods used for microscopic and macroscopic burn-up calculations, the demands for the accuracy of the calculations are given. 26 references. (auth)

Kinetics

Refer also to abstracts 52361, 52860, 52970, and 52971.

52989 (ANL-7684) ARGONNE CODE CENTER: BIBLIOGRAPHIES OF COMPUTER PROGRAM LITERATURE. Harrison C. Jr.; Legan, Marianne (Argonne National Lab., Ill.). Jun 1970. Contract W-31-109-eng-38. 202p. Dep. CFSTI.

A collection of bibliographies of literature on computer programs developed in the areas of nuclear physics, reactor design, operation and engineering is presented. Two such bibliographies form the initial edition; the first containing the reference literature on Argonne Code Center library programs, the second covering literature published during 1967 and 1968 on computer programs in the designated areas. Each bibliography is divided into three sections. The first is a KWIC (keyword in context) subject index. Each keyword is listed alphabetically on the left. The full title from which it was taken is in the center. On the right is the item accession number. The second section (green) is a two-column alphabetical listing of author's names. The item accession number appears on the right. Section three is a listing of the bibliographic items in item accession number order. Asterisks enclose the computer program name in cases where the name is not included in the entry title. (auth)

52990 (LA-4472) REVIEW OF FLUX SYNTHESIS METHODS. Alcouffe, Raymond E. (Los Alamos Scientific Lab., N. Mex.). Jun 1970. Contract W-7405-eng-36. 9p. Dep. NTIS.

Flux synthesis techniques are reviewed with respect to the types of methods currently employed to obtain the detailed neutron flux from lower-order calculations. The areas considered are reactor statics, including the diffusion and transport equations, and reactor dynamics. Recommendations for the implementation and further development of synthesis methods are also included. (50 references) (auth)

52991 (LA-4505) NUMERICAL TECHNIQUES FOR STUDYING REPETITIVELY PULSED REACTOR TIME-DEPENDENT BEHAVIOR. Hopkins, G. C. (Los Alamos Scientific Lab., N. Mex.). Jul 1970. Contract W-7405-eng-36. 6p. Dep. NTIS.

Computationally efficient numerical techniques are developed for studying the time-dependent behavior of repetitively pulsed reactors. Reactivity perturbations synchronous with the external pulse are also considered. Three types of reactivity are considered: step change, sinusoidal, and thermal feedback. Noniterative techniques, based upon Laplace transforms and residues, are used to solve the first two types, and continuous analytic continuation is used to solve the third. (5 references) (auth)

52992 (LIB/Trans-303) STATISTICAL WEIGHT FACTOR FOR CALCULATING XENON EFFECT ON REACTIVITY IN EQUILIBRIUM CONDITIONS. Casini, G.; Pillon, J. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Translated by E. Corran (Australian Atomic Energy Commission Research Establishment, Lucas Heights), from report EUR-102. 19p. Dep. CFSTI (U. S. Sales Only).

A quick method to calculate the Xenon poisoning in the reactor design is shown. By defining a statistical weight factor G, it is possible to evaluate the reactor poisoning by the calculation of the poisoning in one point. Plots of the G factor as a function of the geometrical and flux parameters are given for a cylindrical reactor with a flattened central region. (auth)

52993 (ORNL-tr-2357) ORPHEE VI PROGRAM: ATTENUATION OF FAST NEUTRONS IN A STRUCTURE CONSISTING OF LAYERS OF WATER AND DENSE MATERIAL. Simon, Michel (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from report CEA-N-1244. 20p. Dep. NTIS.

The program ORPHEE VI deals with the attenuation of fast neutrons in a succession of heavy media separated by thin layers of water in a cylindrical geometry. The description of the sources by bundles renders it particularly suited to light water power reactors. It is distinguished by two pecularities: the attenuation in the water is treated according to the formalism of the nucleus in water which is different from the straight-line attenuation used for dense materials; and it offers the possibility of taking into account the position of the control rods for the calculation of the fast neutron flux. ORPHEE VI is distinguished from the preceding versions essentially by the method of input of constants and by supplementary option in the choice of the movement of the rods. The program is written in FORTRAN IV for the IBM 360. (auth)

52994 GOZANI'S PULSED NEUTRON TECHNIQUE WITH REPEATED RECYCLING OF ANALYZER BETWEEN BURSTS. Chow, R. H. (Battelle-Northwest, Richland, Wash.). Nucl. Sci. Eng.; 41: 298-9(Aug 1970).

The formulation by Gozani (NSA 19: 40151) of the theory of modified pulsed source technique is extended to include the case where the recording analyzer is recycled repeatedly between neutron bursts to accumulate counts from the delayed neutron tail. Although room return effect can no longer be isolated, it is strongly suppressed by the repeated superposition of the true delayed neutrons. An expression for the reactivity ρ is obtained in terms of experimental parameters, a correction factor weakly dependent on ρ, and the initial prompt neutron density, obtained experimentally. (R.W.R.)

52995 CONTRIBUTION TOWARD THE OPTIMIZATION OF REACTOR SYSTEMS. Raff, S. (Technical Univ., Berlin). Atomwirt., Atomtech.; 15: 435-6(Sep-Oct 1970). (In German).

One-dimensional time-independent problems, as they occur in the arrangement of reactor cores with simple geometry, can be treated by means of Pontryagin's maximum principle. Refinement of reactor models, requiring calculation of multi-dimensional problems, necessitates modification of the maximum principle through classical variational calculation. The mathematical method is described in 17 equations. Since the procedure is based on classical principles, its applicability to non-classical variational functions remains undetermined. 13 references. (H.B.G.)

52996 SIMPLIFIED MODELS OF ZENON SPATIAL OSCILLATIONS. Olsson, Gustaf (Lund Inst. of Tech., Sweden). Atomkerenergie; 16: 91-8(1970).

Simplified models of the Xe spatial instability, especially axial oscillations, are derived. The nature of the oscillations makes it possible to represent the axis of the core with only two points. This simple model gives a good physical insight into the problem and is shown to be rather accurate, compared with other models. Both unstable and stable periodic solutions are predicted with the non-linear model. They are verified by digital simulation. The linear stability is shown to be independent of the control rod, which maintains the criticality. The rod will, however, influence the non-linear behavior. (17 references) (auth)

52997 TRANSPORT THEORETICAL CALCULATION OF FAST FISSION FACTORS. Leuthaeuser, K. D. (Univ., Kiel). Atomkernenergie; 16: 119-22(1970).

The transport theoretical method of singular eigenfunction expansions is applied to the calculation of fast neutron multiplication in subcritical slabs and spheres. 12 references. (auth)

52998 CONDITIONAL VARIANCES PERTINENT TO DOPPLER EFFECT STUDIES. Hwang, R. N.; Miller, L. B. (Argonne National Lab., Ill.). Nucl. Sci. Eng.; 42: 179-90 (Nov 1970).

The statistical uncertainties of the self-shielded group cross section and its temperature derivative associated with the use of the biased selection technique where resonances are chosen to match the observed value of the unshielded cross section are discussed. Since the self-shielded group cross section can always be pictured as a superposition of an infinitely dilute term and a self-shielding term, the problem amounts to the estima-

tion of the conditional variances of the self-shielding term and its temperature derivative for any given value of the infinitely dilute cross section. A semianalytical method based on the NR-approximation has been developed to estimate these conditional variances. Both qualitative and quantitative discussions are given for cases of ^{239}Pu and ^{238}U under various physical conditions. (auth)

Dynamics

Refer also to abstracts 52859 and 52864.

52999 ACOUSTIC INSTABILITIES IN A REACTOR WITH A CIRCULATING GAS FUEL. Goryachenko, V. D.; Sabaev, E. F. This paper was summarized in At. Energ. (USSR); 24: 375(Apr 1968) as paper No. 198. (In Russian).

The stability of a nuclear reactor (steady-state mode) with a circulating gas fuel is studied in relation to acoustic instabilities. As the initial mathematical model the neutron balance equation and the system of gas dynamic equations in the one-dimensional idealization are used. The initial equations of dynamics are linearized and then, using the method of straight lines, are transformed to a system of ordinary differential equations. Two numerical methods are considered for analyzing stability. The first method is based on setting up the characteristic equation, performing an analytic transformation using an electronic computer, and then isolating the stability region in the space of reactor parameters (also using an electronic computer). The second method is based on estimating the stability from the form of the transient processes in the linearized model. A theorem is derived making it possible to determine the asymptotic stability from an analysis of the change in a part of the variables. A comparison of the proposed methods is given and their application to the construction of stability region boundaries is described. It is established that both methods provide similar results and specific calculations totally confirm the quantitative conclusions on the conditions for acoustic instability. The effect of the neutron lifetime and steady-state flow rate of the circulating fuel on stability is studied. It is shown that an increase in the first parameter aids in stability and the reasons for this are explained. It is seen that the second parameter will not effect stability when the circulation rate is much less than the speed of sound. (auth)

Experimental Applications

Refer also to abstract 52782.

53000 (MIT-3944-1) REACTOR PHYSICS PROJECT PROGRESS REPORT. Driscoll, M. J.; Thompson, T. J. (eds.) (Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). 30 Sep 1968. Contract AT(30-1)-3944. 107p. (MITNE-96). Dep. NTIS.

An experimental and theoretical program to develop and apply single and few element methods for the determination of reactor lattice parameters is described. During the period covered, January 1, 1968 through September 30, 1968, work was devoted to development and evaluation of methods for the experimental determination of the heterogeneous fuel rod parameters Γ, η and A. The first of these parameters, the thermal constant Γ, is related to the thermal utilization; η is the total fast neutron yield per thermal neutron absorbed; and the epithermal absorption parameter, A, is related to the resonance escape probability. Exponential tank experiments were completed which show that Γ and η can be measured using foil activation traverses external to a single fuel element. Numerical experiments were performed using multigroup codes to demonstrate the feasibility of a proposed method for determination of A. Analytic work focused on development of methods for calculation of the material buckling, B_m^2, for full lattices from measured values of Γ, η and A, and on correction of these parameters for interaction effects. Work was also initiated with the objective of applying advanced gamma spectrometric methods using Ge(Li) detectors to the determination of fuel rod parameters. Capture gamma spectra were measured for a number of low and high enrichment, and depleted, fuel specimens. A report was issued on a computer program developed to extract photopeak energies and intensities from multi-channel analyzer spectra. (auth)

53001 (MIT-3944-4) REACTOR PHYSICS PROJECT PROGRESS REPORT NO. 2. Driscoll, M. J.; Kaplan, I.; Lanning, D. D. (eds.) (Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). 30 Sep 1969. Contract AT(30-1)-3944. 39p. (MITNE-111). Dep. NTIS.

An experimental and theoretical program to develop and apply single and few element heterogeneous methods for the determination of reactor lattice parameters is described. During the period covered, October 1, 1968 through September 30, 1969, work was primarily devoted to measurement of the heterogeneous fuel element parameters (Γ, η and A) of 19- and 31-rod clusters of plutonium-containing fuel. Methods development research focused on determination of the epithermal absorption constant, A. Calculations and an analysis of data reported in the literature were made to assess the applicability of heterogeneous methods to H_2O-moderated systems. Advanced gamma spectrometric methods using Ge(Li) detectors were applied to the analysis of prompt and delayed gamma spectra from fertile and fissile materials and from fuel elements. These methods were used successfully for nondestructive analysis of the composition of fuel elements. A feasibility study was performed on an in-pile gamma spectrometer. Two fuel pins irradiated to a burnup of approximately 20,000 MWD/MT in the Dresden reactor were received and preparations made for their analysis and use in reactor physics experiments. (auth)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 50439, 50539, 50568, 51152, 51193, 51199, 51232, 51238, and 52850.

53002 IMPROVEMENT IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Eaton, Carl Wilding; McCrerie, Alan Ian (to United Kingdom Atomic Energy Authority). British Patent 1,206,116. 23 Sep 1970. Filed 11 Nov 1966.

Reference is made to cluster type fuel elements, comprising clusters of fuel pins spaced and transversely located by grids within an outer support sleeve. Drawbacks of present fuel elements of this type are described, particularly those associated with weight support, involving the use of concepts of material which interfere with the coolant flow pattern and that introduce a heavy neutron absorption penalty. In the system described the fuel element has a transverse grid at its end which supports the fuel pins axially and is constructed from radial structural members attached to an outer support ring, with a cellular structure for locating the ends of the fuel pins. This support grid is located in an outer support sleeve with the outer support ring interposed between an annular shoulder in the interior of the sleeve and the end of an inner sleeve screwed inside the outer sleeve, but otherwise spaced radially. The fact that the depth of the support grid is kept to a minimum by keeping the cellular structure within the depth of the structural members, in contrast with previous constructional arrangements, means that the length of the end insulating pellet in each fuel pin can be reduced, thereby enabling more fuel in a given length of fuel pin. Also, by securing the fuel pins against axial movement in the support grid, the length of the end insulating pellets can be further reduced. The fuel elements may be elongate and may have a fuel pin spacer grid located at the end opposite to the fuel pin support grid end. A number of alternative structural details are also described. (UK)

53003 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUELLING ARRANGEMENTS. Weaden, Hector Roberts; Parr, Eric (to United Kingdom Atomic Energy Authority). British Patent 1,206,621. 23 Sep 1970. Filed 27 Apr 1967.

Reference is made to reactors of the type having a refueling machine operable at one end face to refuel via access tubes communicating with the core through the pressure vessel and terminating at the end face. In the system described the refueling machine is movable along a gantry that is pivoted at one end, while its other end is supported so as to be movable arc wise and adapted to straddle the end face so the machine can be positioned over any desired access tube termination. The system is particularly applicable to an installation comprising at least two reactors with their refueling end faces in proximity, the gantry being movable angularly to straddle both end faces so that the machine can be positioned to refuel any core channel of either reactor. Where the installation comprises four reactors there may be two gantries and refueling machines arranged for independent operation; in this case a common pivot for the gantries may be provided, with the gantries at different levels on the pivots. Where heat exchangers are contained within holes or recesses in the pressure vessel wall the gantries may carry a crane or hoist for withdrawing and replacing defective heat exchangers. (UK)

53004 CALCULATION OF THE NUCLEAR FUEL MANUFACTURING COSTS. Steinbock, P.; Zuechner, J. (Technische Univ., Dresden). Kernenergie; 13: 199-202(Jul 1970). (In German).

Starting from the tasks and position of fuel production within the fuel cycle, a formula for analytical calculation of the manufacturing costs has been derived. Further factors of influence and viewpoints in economical simulation of the fuel cycle are pointed out. (auth)

53005 IMPROVEMENTS IN AND RELATING TO A LOWER TUBE BLOCK FOR A NUCLEAR REACTOR VESSEL. Martin, Georges (to Societe des Forges et Ateliers du Creusot). British Patent 1,209,391. 21 Oct 1970. Priority date 23 Mar 1967, France.

PRESSURE VESSELS—supports for, description of prestressed concrete

REACTORS—pressure vessel support for, description of prestressed concrete (D.C.C.)

53006 PRESSURE VESSELS FOR CONTAINING NUCLEAR REACTORS. (to Etudes de Genie Civil et de Techniques Industrielles). British Patent 1,208,600. 14 Oct 1970. Priority date 18 Nov 1966, France.

PRESSURE VESSELS—design parameters of steel lined prestressed concrete

REACTORS—pressure vessels for, description of steel lined prestressed concrete (D.C.C.)

53007 APPARATUS FOR CONTROLLING A CONTROL ROD IN A NUCLEAR REACTOR. Winders, Gordon R. (to Babcock and Wilcox Co.). U. S. Patent 3,527,670. 8 Sep 1970. Filed 14 Dec 1967.

An apparatus for controlling a control rod in a nuclear reactor is described which consists of a control rod that is hydraulically movable in and out of the reactor core. A hydraulically operated actuator disposed within the nuclear reactor has a first fluid line extending from the actuator to a source of fluid disposed externally of the reactor. The first line has a first valve arranged to admit fluid to the actuator from the source for raising the control rod. A second line connected to the first line between the first valve and the reactor extends to a low pressure receiver. The second line has a second valve arranged to remove fluid from the actuator to the receiver for lowering the control rod. A means for latching the control rod is provided to normally hold the control rod in the core. The valves are alternately opened and closed in a predetermined sequence to first lower the control rod to release the latch before the rod can be raised out of the core. (Offic. Gaz.)

53008 CHARGING DEVICE FOR NUCLEAR REACTORS. (to Brown Boveri/Krupp Reaktorbau GmbH). British Patent 1,209,137. 21 Oct 1970. Priority date 12 Jun 1968, Germany.

REACTOR LOADING MACHINES—design for sphere shaped fuel elements and rod type control elements (D.C.C.)

53009 IMPROVEMENTS IN AND RELATING TO APPARATUS FOR REMOVING LUGS OF NUCLEAR FUEL ELEMENT CANS. Nicol, James Miller; Jakobek, Tadeusz Zenon; McGlone, John Joseph (to Babcock and Wilcox, Ltd.). British Patent 1,206,856. 30 Sep 1970. Filed 15 Jul 1968.

Apparatus is described for removal of lugs from reactor fuel element cans comprising means for traversing a can longitudinally relative to a guillotine unit and relative to an orientating block that provides a passage for the can in the direction of the guillotine unit in any orientation on its axis. The block is provided with grooves for accommodating the can lugs, the widths of the grooves tapering towards lug outlets corresponding to a can orientation suitable for shearing in the guillotine unit. An adaptation is also described for removing lugs from fuel elements having lugs at four positions spaced equiangular around their peripheries. In this case the lug outlets extend respectively laterally, upwardly and downwardly at the ends of lateral, upper and lower grooves. A support trough is arranged for supporting the can before and as it enters the orientating block, together with pushing means for traversing the can longitudinally relative to the trough, the orientating block and the guillotine unit. Details of various designs of pushing means are given. A further support trough may be provided for the can as it leaves the guillotine unit; also a turning block between the guillotine unit and the second support trough, adapted to rotate the can through 90°, with further pushing means for moving the can in the return direction into the first support trough. Various alternatives are also described. (UK)

53010 EULER: LIQUID RODS FOR NUCLEAR REACTOR CONTROL. Agazzi, Alberto; Broggi, Armando; Galli De Paratesi, Sergio (Joint Research Centre, Ispra, Italy). Euro-Spectra; 9: 83-90(Sep 1970).

The development of liquid control rods for reactors is discussed Prototype systems with liquid control rods are described. Advantages and disadvantages are listed. (11 references) (D.C.C.)

GENERAL

53011 (ACRH–1000-199) INCREASED TURNOVER OF MITOCHONDRIAL CONSTITUENTS IN CARDIAC HYPERTROPHY AND ACUTE HYPOXIA IN THE RAT. Aschenbrenner, V.; Albin, R.; Zak, R.; Nair, K. G.; Rabinowitz, M. (Chicago Univ., Ill. Argonne Cancer Research Hospital, Chicago, Ill.). Jun 1970. Contract AT(11-1)-69. 15p. (CONF-700626-1). Dep. CFSTI.
From 3rd Annual Meeting of the International Study Group for Research in Cardiac Metabolism, Stowe, Vt.

53012 (ACRH–1000-217) SYNTHESIS OF COLLAGEN, MYOSIN, NON-COLLAGENOUS PROTEIN, AND DNA DURING EXPERIMENTAL MYOCARDIAL HYPERTROPHY IN THE RAT. Skosey, J. L.; Aschenbrenner, V.; Zak, R.; Rabinowitz, M. (Chicago Univ., Ill. Argonne Cancer Research Hospital, Chicago, Ill.). Jun 1970. Contract AT(11-1)-69. 8p. (CONF-700626-2). Dep. CFSTI.
From 3rd Annual Meeting of the International Study Group for Research in Cardiac Metabolism, Stowe, Vt.

53013 (AEC-tr–6869/9) UKRAINIAN PHYSICS JOURNAL. Translation of Ukr. Fiz. Zh.; 12: 1409-1582(1967). 173p. (TT–67-51421/9; IPST-Cat.–5069). Dep. NTIS.

53014 (AEC-tr–6869/10) UKRAINIAN PHYSICS JOURNAL. Translation of Ukr. Fiz. Zh.; 12: 1589-1755(1967). 160p. (TT–67-51421/10; IPST-Cat.–5070). Dep. NTIS.

53015 (AEC-tr–6869/11) UKRAINIAN PHYSICS JOURNAL. Translation of Ukr. Fiz. Zh.; 12: 1777-1929(1967). 142p. (TT–67-51421/11; IPST-Cat.–5071). Dep. NTIS.

53016 (AEC-tr–7103) COMPUTER ELEMENTS AND SYSTEMS. Collection of Papers Issues Nos. 26–28, 1967. Translation of Vychisl. Sist.; Nos. 26, 27, 28, 1967. 227p. (TT–70-50010; IPST-Cat.–5660-5662). Dep. CFSTI.

53017 (AEC-tr–7104) COMPUTER ELEMENTS AND SYSTEMS. Collection of Papers. Issues Nos. 29-31, 1968. Translation of Vychisl. Sist.; Nos. 29, 30, 31, 1968. 286p. (TT–70-50011; IPST-Cat.–5663-5665). Dep. NTIS.

53018 (ANL-Trans–850) ELECTRONIC BLOOD CELL VOLUME DETERMINATION AND ITS SOURCES OF ERROR. Thom, R.; Hampe, A.; Sauerbrey, G. Translated for Argonne National Lab., Ill., from Z. Gesam. Exp. Med.; 151: 331-49(1969). 25p. Dep. CFSTI.

53019 (BDX–613-144) THIRD-DIRECTION REINFORCEMENT OF CARBONIZED COMPOSITES. Darbyshire, H. F. (Bendix Aerospace-Electronics Co., Kansas City, Mo.). Aug 1970. Contract AT(29-1)-613. 59p. Dep. NTIS.

53020 (BDX–613-155) BORON SHOT GRADING AND INSPECTING. Napier, Michael J. (Bendix Corp., Kansas City, Mo.). Sep 1970. Contract AT(29-1)-613. 7p. Dep. NTIS.

53021 (BDX–613-169) INFRARED REFLOW SOLDERING. Hughs, R. W. (Bendix Aerospace-Electronics Co., Kansas City, Mo.). Jul 1970. Contract AT(29-1)-613. 35p. Dep. NTIS.

53022 (BDX–613-209) MEDIUM DENSITY MOLDED FOAM. Fender, J. R. (Bendix Aerospace-Electronics Co., Kansas City, Mo.). Aug 1970. Contract AT(29-1)-613. 26p. Dep. NTIS.

53023 (BDX–613-229) NEW TECHNIQUE FOR DETERMINING IN HETEROGENEOUS MEDIA: PLASTIC FOAM. Liou, D. W.; Lee, W. M. (Bendix Aerospace-Electronics Co., Kansas City, Mo.). Sep 1970. 31p. Dep. NTIS.

53024 (BNL–50241) ACCURATE, LONG-RANGE EXTRAPOLATION: THE PADE APPROXIMANT. Brookhaven Lecture Series Number 81. Baker, George A. Jr. (Brookhaven National Lab., Upton, N. Y.). 19 Feb 1969. 6p. Dep. CFSTI.

53025 (BNL-tr–360) ANTIBIOTIC PROPERTIES OF SOME LACTOBACILLI. Patrushev, S. V. Translated by S. J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from Veterinariya; 46: No. 2, 1969. 6p. Dep. NTIS.

53026 (BNWL-SA–2522) FAULT TREES FOR RELIABILITY ANALYSIS. Schroder, R. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct 1969. Contract AT(45-1)-1830. 24p. (CONF-700215-1). Dep. CFSTI.
From Annual Symposium on Reliability, Los Angeles, Calif.

53027 (CALT–767-P 3-11) MOBILITY OF BASAL DISLOCATIONS INTERACTING WITH NON BASAL DISLOCATIONS IN ZINC. Nagata, Norio; Vreeland, T. Jr. (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). [1970]. Contract AT(04-3)-767. 5p. (CONF-700819-2). Dep. CFSTI.
From 2nd International Conference on the Strength of Metals and Alloys, Pacific Grove, Calif.

53028 (CALT–822-14) AMORPHOUS ALLOY RESISTANCE THERMOMETER FOR LOW TEMPERATURE. Tsuei, C. C.; Duwez, Pol (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Oct 1970. Contract AT(04-3)-822. 4p. Dep. NTIS.

53029 (CALT–822-15) MAGNETIC PROPERTIES OF AN AMORPHOUS Mn–P–C ALLOY. Hasegawa, Ryusuke (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Nov 1970. Contract AT(04-3)-822. 12p. Dep. NTIS.

53030 (COO–1018-1214) QUARTERLY TECHNICAL PROGRESS REPORT, APRIL–JUNE 1970. (Illinois Univ., Urbana. Dept. of Computer Science). 213p. (COO–1469-173). Dep. NTIS.

53031 (COO–1198-749) EFFECT OF HIGH PRESSURE ON SELF-DIFFUSION IN BETA–TITANIUM. Jeffery, Rondo Nelden (Illinois Univ., Urbana). Oct 1970. Contract AT(11-1)-1198. 88p. Dep. CFSTI.
Thesis.

53032 (COO–1222-41) SEPARATIONS OF ENANTIOMERIC DERIVATIVES OF AMINES AND AMINO ACIDS BY ADSORPTION CHROMATOGRAPHY. Corbin, J. A.; Rogers, L. B. (Purdue Univ., Lafayette, Ind. Dept. of Chemistry). [1970]. Contract AT(11-1)-1222. 20p. Dep. CFSTI.

53033 (COO–1242-32) STUDIES ON CARBOHYDRATES AND OXIDATIVE METABOLISM. Technical Progress Report. Utter, Merton F. (Case-Western Reserve Univ., Cleveland, Ohio). 30 Sep 1970. Contract AT(11-1)-1242. 19p. Dep. CFSTI.

53034 (COO–1431-9) EFFECT OF ANNEALING ON THE SUBSTRUCTURE OF COLD WORKED fcc METALS AND ALLOYS. Technical Progress Report No. 6, September 1, 1969–September 1, 1970. Mikkola, D. E.; Borich, D. J.; Rase, C. L. (Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering). Contract AT(11-1)-1431. 22p. Dep. NTIS.

53035 (COO–1562-11) MEMBRANE-BOUND CANAVANINE-CONTAINING PROTEINS IN NORMAL AND T4-INFECTED ESCHERICHIA COLI. Allen, Theodore D.; Rogers, Palmer (Minnesota Univ., Minneapolis). [nd]. Contract AT(11-1)-1562. 7p. (CONF-700539-1). Dep. NTIS.
From American Society for Microbiology Annual Meeting, Boston, Mass.

53036 (COO–1783-9) A STUDY OF INTERMEDIARY METABOLISM OF CARBOHYDRATES WITH ISOTOPICALLY LABELED COMPOUNDS. Progress Report. Wood, Harland G. (Case-Western Reserve Univ., Cleveland, Ohio). [30 Sep 1970]. Contract AT(11-1)-1783. 33p. Dep. NTIS.

53037 (CTC–36) CIRK: CTC's INFORMATION RETRIEVAL FROM KEYWORDS. Owings, J. H.; Price, C. E. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). 1 Oct 1970. Contract W-7405-eng-26. 39p. Dep. NTIS.

53038 (CTC–39) COMPUTING TECHNOLOGY CENTER NUMERICAL ANALYSIS LIBRARY. Westley, G. W.; Watts, J. A. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). 5 Oct 1970. Contract W-7405-eng-26. 462p. Dep. NTIS.

53039 (GEAP–10170) THE EFFECT OF STRESS CONCENTRATION ON THE LOW-CYCLE FATIGUE OF THREE LOW-STRENGTH STRUCTURAL STEELS AT ROOM TEMPERATURE AND 550°F. Krempl, E. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Mar 1970. Contract AT(04-3)-189. 42p. Dep. NTIS.

53040 (IS–2361) PRE-SCAN PROCESSOR FOR TASK. Wallentine, V. E. (Ames Lab., Iowa). Sep 1970. Contract W-7405-eng-82. 97p. Dep. NTIS.

53041 (IS-2373) USE OF DYNAMIC SYMBOL TABLES FOR SPELLING CORRECTION IN SYSTEMS PROGRAMS. Hedrick, G. E. (Ames Lab., Iowa). Sep 1970. Contract W-7405-eng-82. 8p. Dep. NTIS.

53042 (IS-2411) USER ERROR ANALYSIS AND AUTOMATIC CORRECTION FOR COMPILING. Hedrick, G. E.; Lambert, R. J. (Ames Lab., Iowa). Oct 1970. Contract W-7405-eng-82. 205p. Dep. NTIS.
Thesis.

53043 (IS-T-397) THE CRYSTAL STRUCTURE DETERMINATIONS OF TETRAETHYLAMMONIUM HEXABROMOANTIMONATE(V), 4-ETHYLPYRIDINUM TETRABROMOFERRATE (III), AND D-GLUCONO-(1,5)-LACTONE, AND A METHOD FOR PARTIAL STRUCTURE EVALUATION. Hackert, Marvin LeRoy (Ames Lab., Iowa). Sep 1970. Contract W-7405-eng-82. 85p. Dep. CFSTI.
Thesis.

53044 (K-Trans-57) HEAT TRANSFER AND PRESSURE DROP DURING CONDENSATION OF REFRIGERANT VAPORS IN AIR-COOLED CONDENSERS. Schulenberg, F. Translated for Oak Ridge National Lab., Tenn., from Kaeltetech.-Klim.; 22: No. 3, 75-81(1970). 21p. Dep. NTIS.

53045 (K-Trans-58) HIGH-CAPACITY AIR-COOLED CONDENSERS AND THEIR ECONOMY. Schmidt, Th. E. Translated for Oak Ridge National Lab., Tenn., from International Conference on Refrigerating Technology, Ostend, Belgium, September 27-28, 1968. 16p. (CONF-680982-1). Dep. NTIS.

53046 (K-Trans-59) AIR-COOLED CONDENSERS FOR LARGE REFRIGERATION UNITS OF THE CHEMICAL INDUSTRY. Schulenberg, F. J. Translated for Oak Ridge National Lab., Tenn., from Progress in Refrigeration Science and Technology, Volume I. 13p. (CONF-670802-3). Dep. NTIS.
From 12th International Congress of Refrigeration, Madrid, Spain.

53047 (K-Trans-60) HEAT TRANSFER AND PRESSURE VARIATION IN THE CONDENSATION OF FLOWING STEAM IN INCLINED TUBES. Schulenberg, Franz J. (Stuttgart Univ. (West Germany)). Translation of thesis. 135p. Dep. NTIS.

53048 (LA-4416) GRADPRO: A COMPUTER PROGRAM FOR USE IN ISOPYCNIC DENSITY GRADIENT CENTRIFUGATION. Dean, P. N.; Noland, B. J.; Shepherd, G. R. (Los Alamos Scientific Lab., N. Mex.). Sep 1970. Contract W-7405-eng-36. 10p. Dep. CFSTI.

53049 (LA-4498) WAVELENGTHS AND ENERGY LEVELS OF SINGLY IONIZED COPPER, Cu II. Ross, Charles B. (Los Alamos Scientific Lab., N. Mex.). Aug 1970. Contract W-7405-eng-36. 73p. Dep. NTIS.

53050 (LA-tr-70-21) VELOCITY OF SOUND IN IRON AND IRON ALLOYS IN THE SOLID AND MOLTEN STATE. Kurz, W.; Lux, B. Translated for Los Alamos Scientific Lab., N. Mex., from High Temp.-High Pressures; 1: 387-99(1969). 21p. Dep. NTIS.

53051 (MIT-1965-81) VIBRATIONAL STUDIES OF DINUCLEAR COMPOUNDS CONTAINING QUADRUPLY BONDED PAIRS OF MOLYBDENUM AND RHENIUM ATOMS. Bratton, W. K.; Cotton, F. A.; Debeau, M. (Massachusetts Inst. of Tech., Cambridge); Walton, R. A. (Reading Univ. (England). Purdue Univ., Lafayette, Ind.). [1970]. 39p. Dep. NTIS.

53052 (NYO-3497-24) PLANKTON ECOLOGY PROJECT STATION DATA, AESOP CRUISES 1-12, APRIL 1969-MARCH 1970. Special Report 16. Taylor, W. Rowland; Cronin, W. B.; Mason, A. (Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.). May 1970. Contract AT(30-1)-3497. 78p. Dep. CFSTI.

53053 (NYO-3707-6) ROLE OF THE CARRIER IN ANTIBODY FORMATION. Progress Report, March 1, 1969-June 1, 1970. Plescia, Otto J. (Rutgers-The State Univ., New Brunswick, N. J. Inst. of Microbiology). Contract AT(30-1)-3707. 10p. Dep. CFSTI.

53054 (ORNL-HUD-16) FEASIBILITY OF RETRIEVING UTILITY SYSTEM CAPITAL AND MAINTENANCE COSTS FROM ANNUAL REPORTS. Boegly, W. J. Jr.; Griffith, W. L. (Oak Ridge National Lab., Tenn.). Jun 1970. Contract W-7405-eng-26. 52p. Dep. NTIS.

53055 (ORNL-TM-3120) MSF EVAPORATOR FLOW ANALYSIS: THE SUBMERGED JET MODEL AND THE EFFECT OF BAFFLES ON FLOW STABILITY. Wichner, R. P. (Oak Ridge National Lab., Tenn). Oct 1970. Contract W-7405-eng-26. 46p. Dep. NTIS.

53056 (ORNL-tr-2375) THE ANNEALING OF QUENCHED-IN VACANCIES IN THE Al-Zn ALLOYS AND ITS INFLUENCE ON THE KINETICS OF THE COARSENING PROCESS OF GUINIER-PRESTON ZONES. Gerold, Volkmar; Merz, Wilfried; Kawanoo, Osamu. Translated for Oak Ridge National Lab., Tenn., from Z. Metallk.; 61: 102-7(1970). 14p. Dep. NTIS.

53057 (ORNL-tr-2379) PREPARATION AND PROPERTIES OF THE OXYCHLORIDES OF CERIUM AND LANTHANUM. Matthes, F.; Haeseller, G.; Poeschl, R. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.) from J. Less-Common Metals; 10: 344-7(1966). 4p. Dep. NTIS.

53058 (ORO-2825-30) ELECTRON PARAMAGNETIC RESONANCE STUDIES OF SOME Cu(II) COMPLEXES WITH ORGANOPHOSPHORUS CHELATES. Joesten, Melvin D.; Koch, Richard C.; Martin, Thomas W.; Venable, John H. Jr. (Vanderbilt Univ., Nashville, Tenn.). [1970]. 15p. Dep. NTIS.

53059 (SC-DC-70-4932) QUARTZ GAUGE TECHNIQUE FOR IMPACT EXPERIMENTS. Ingram, G. E.; Graham, R. A. (Sandia Labs., Albuquerque, N. Mex.). Jun 1970. 19p. (CONF-700803-7). Dep. CFSTI.
From 5th Symposium on Detonation, Pasadena, Calif.

53060 (SC-DR-70-380) THERMAL EFFECTS SIMULATING DEVICE FOR PRESSURE TRANSDUCERS. Newman, R. G. (Sandia Labs., Albuquerque, N. Mex.). Sep 1970. 12p. Dep. NTIS.

53061 (SC-DR-70-483) DEVELOPMENT OF SEA ICE PENETROMETER. Young, C. W., Kiker, J. L. (Sandia Labs., Albuquerque, N. Mex.). Aug 1970. 85p. Dep. NTIS.

53062 (SC-R-70-4286) DEVELOPMENT OF A HUMAN ERROR RATE DATA BANK. Swain, A. D. (Sandia Labs., Albuquerque, N. Mex.). Jul 1970. 36p. (CONF-700704-1). Dep. CFSTI.
From U. S. Navy Human Reliability Workshop, Washington, D. C.

53063 (SC-RR-70-601) NOTES ON SOLVING Ax = b. Shampine, L. F. (Sandia Labs., Albuquerque, N. Mex.). Sep 1970. 22p. Dep. NTIS.

53064 (SC-RR-70-608) SEMIAUTOMATED, DIGITAL MICROWAVE, IMPEDANCE ANALYZER. Chaffin, R. J.; Gerst, T. E. (Sandia Labs., Albuquerque, N. Mex.). Sep 1970. 48p. Dep. NTIS.

53065 (SC-RR-70-622) CONCERNING THE HIGH-TEMPERATURE THERMAL CONDUCTIVITY OF CARBON FOAMS. Corll, J. A. (Sandia Labs., Albuquerque, N. Mex.). Sep 1970. 53p. Dep. NTIS.

53066 (SCL-DR-70-107) MULTICHANNEL DATA DIGITIZING AND RECORDING SYSTEM WITH REMOTE INTERROGATION. Hopwood, J. E. (Sandia Labs., Albuquerque, N. Mex.). Oct 1970. Contract AT(29-1)-789. 48p. Dep. NTIS.

53067 (SCL-DR-70-237) STRING ANALYSIS BY SIMPLE PRECEDENCE PARSERS. Tichenor, D. A. (Sandia Labs., Albuquerque, N. Mex.). Sep 1970. Contract AT(29-1)-789. 67p. Dep. CFSTI.

53068 (UCB-34-P-167-2) THE BIOLOGICAL SYNTHESIS OF PROTEIN: ERYTHROBLAST MATURATION AND HEMOGLOBIN SYNTHESIS. Progress Report, October 1, 1969-September 30, 1970. (California Univ., Berkeley. Space Sciences Lab.). Contract AT(04-3)-34. 33p. Dep. CFSTI.

53069 (UCRL-19620) FRACTURE CHARACTERISTICS OF METASTABLE AUSTENITIC STEELS UNDER CYCLIC LOADING. Chanani, Govind Ram (California Univ., Berkeley. Lawrence Radiation Lab.). Jul 1970. Contract W-7405-eng-48. 183p. Dep. NTIS.

53070 (UCRL-19644) DIFFUSION STUDIES IN THE ALUMINA-SILICA SYSTEM. Davis, Robert Foster (California Univ., Berkeley. Lawrence Radiation Lab.). Jul 1970. Contract W-7405-eng-48. 115p. Dep. NTIS.
Thesis.

53071 (UCRL-19649) ROTATIONAL PERTURBATIONS AND LOW-LYING ELECTRONIC STATES OF CaO. Johansen, Helen (California Univ., Berkeley. Lawrence Radiation Lab.). Aug 1970. Contract W-7405-eng-48. 108p. Dep. NTIS.
Thesis.

53072 (UCRL-19666) FAR INFRARED STUDIES OF SOLIDS: I. ELECTRONIC LEVELS OF d^1IONS IN Al_2O_3. II. PHONON CONTRIBUTION TO ELECTROMAGNETIC ABSORPTION IN LEAD. Joyce, Richard Ross (California Univ., Berkeley. Lawrence Radiation Lab.). Aug 1970. Contract W-7405-eng-48. 119p. Dep. NTIS.
Thesis.

53073 (UCRL-19668) CHARACTERIZATION OF SINTERING PHENOMENA OF $(Na_{0.5}K_{0.5})NbO_3$. Stannek, Wolfgang (California Univ., Berkeley. Lawrence Radiation Lab.). Jul 1970. Contract W-7405-eng-48. 72p. Dep. NTIS.
Thesis.

53074 (UCRL-19689) CHEMISTRY OF STANNANE. Webster, John Robert (California Univ., Berkeley. Lawrence Radiation Lab.). Sep 1970. Contract W-7405-eng-48. 68p. Dep. NTIS.
Thesis.

53075 (UCRL-20115) GENETIC CONTROL OF MUTATION INDUCTION IN SACCHAROMYCES CEREVISIAE. Lemontt, Jeffrey Fielding (California Univ., Berkeley. Lawrence Radiation Lab.). Sep 1970. Contract W-7405-eng-48. 125p. Dep. NTIS.
Thesis.

53076 (UCRL-50914) COMPARISON OF SOME LUNG-DEPOSITION MODELS USED IN THE SAMPLING OF RESPIRABLE DUST. Cohen, Jerry J.; Montan, Donald N. (California Univ., Livermore. Lawrence Radiation Lab.). 7 Aug 1970. 7p. Dep. CFSTI.

53077 (UCRL-Trans-10489) MICRODETERMINATION OF THE CARBON AND HYDROGEN IN ORGANIC COMPOUNDS BY COMBUSTION AND WEIGHING OF THE CARBON DIOXIDE AND WATER. Cousin, Bernard. Translated by T. Dudley for Univ. of California Lawrence Radiation Lab., Livermore, from Bull. Soc. Chim. Fr.; No. 8, 2915-19(1969). 21p. Dep. NTIS.

53078 (UCRL-Trans-10490) CRITICAL INITIATION PRESSURES OF EXPLOSIVES. Afanasenkov, A. N.; Bogomolov, V. M.; Voskoboinikov, I. M. Translated by A. M. Mincer for Univ. of California Lawrence Radiation Lab., Livermore, from Vzryvnoe Delo, Nauch.-Tekh. Gorn. Obshchest., Sb.; No. 68/25, 68-92(1970). 49p. Dep. NTIS.

53079 (UCSF-10-P-2-117) TISSUE CULTURE EXPERIMENTS IN HEREDITARY SKIN CANCER: DNA REPAIR SYNTHESIS. Riccardi, Vincent M.; Cleaver, J. E. (California Univ., San Francisco. Lab. of Radiobiology). [1970]. Contract AT(11-1)-Gen-10. 19p. Dep. NTIS.

53080 (USGS-474-69) ESTIMATION OF IN SITU ACOUSTIC PROPERTIES OF VOLCANIC ROCKS FROM COMPRESSIONAL VELOCITY MEASUREMENTS: CENTRAL NEVADA. Carroll, R. D.; Paul, J. E. (Geological Survey, Denver, Colo.). 1970. 28p. Dep. NTIS.